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THE EXPORT TRADE.

The figures of electrical export trade for the month of July are, in the main, similar to those of the months more immediately preceding, and are in keeping with those of general commerce. The export of heavy electrical machinery reached a value of only $391,195, as compared with $523,355 in July, 1908. The export of electrical instruments and apparatus amounted to $567,795, as compared with $429,080. The two items make a total of $958,990 in 1909, as compared with $952,435 in 1908. This is an obvious gain, though very small, yet larger than appears on the surface if we consider the lower range of prices. At any rate, such figures encourage us to believe that, as was indicated a month ago, the tide has turned.

The detailed data are of interest. Just why there should be the steady decline in the foreign demand for heavy electrical machinery is not apparent, except on the ground of universal poor trade or else on that of inability to meet the market. But if there were still generally poor trade it would be hard to explain fully the briskness in electrical instruments. Possibly our foreign competitors have cut prices deeply. One of the odd features of the situation is that France increased its purchases from $13,346 to $125,018, the only really large amount in a somewhat insignificant total. The increase may have something to do with the new activity in electric railway work in the Republic. As for the remainder of the $391,195, North America with orders for $80,199 and Mexico with $48,486 remain our best customers.

The development in the miscellaneous trade is encouraging, and we hope it will keep up. There is an endless variety of electrical apparatus made here that ought to be advertised and pushed, especially in North and South America, Mexico, Australasia and Africa; and the figures certainly indicate that somebody is buying, even if someone is not hustling very energetically to find him out. The gains in this branch have been coming all the year, and July, instead of being a dull, dead month, was one of the best of the seven, with a gain of nearly $150,000, or almost 40 per cent, over July, 1908. This is "going some," and, if it can be kept up, will more than compensate for loss on machinery, should that be permanent. It would imply, anyhow, a demand of wider range and, therefore, safer from downward fluctuations. Once more, British North America looms up well with orders for $176,619, but our "next best friend" was Brazil with $134,517; while Mexico took goods worth $65,072. When we point out that of the total $567,795 for "instruments" no less than $462,614 went to countries north and south of us, the manufacturer may consider himself justified in looking on the Americas as his best customers; but there does not seem any good reason, save possibly in one or two European countries, why purchasers for such apparatus should not be waiting everywhere.

Convention of Railway Electrical Engineers.

An organization of engineers which has reached within one year a membership four times as large as the maximum predicted by its enthusiastic founders deserves more than a passing notice. Such an organization is the Association of Railway Electrical Engineers which came into existence somewhat more than one year ago as the Association of Car Lighting Engineers. Its membership enrollment of 400 was well represented at its second annual convention held in Chicago from Oct. 4 to 7, as noted elsewhere in this issue. Organized with the object of advancing the knowledge pertaining to the principles, design, construction, maintenance and operation of car-lighting and electrical appliances, the Association has already accomplished much good in securing recognition of the undesirability of numerous lamp voltages and car circuit interconnectors. By standardizing certain details which can well be similar in all types of electric car lighting equipments, the interchange of cars between railroads will be facilitated and thereby the introduction of electric train lighting will be hastened. Second in importance only to the work of standardization are the exchange of ideas and reports of experience concerning the various train lighting systems in service, in order that the best of each system may be retained for the several systems that will some day be looked upon as standard. The association has assigned to itself important tasks, and the record of the last convention indicates that the work will be accomplished in a highly creditable manner. We may point out, however, that haste should be made slowly in fixing standards, which remark applies particularly to railroad standards owing to the disinclination to change which characterizes railroad practice. For example, in adopting a lamp voltage, there should be very strong reasons for ignoring the 50-volt commercial standard as a basis, in favor of 64 volts as proposed.

Grounding the Secondary.

Elsewhere we print resolutions adopted at the recent annual meeting of the Association of Municipal Electricians in favor of grounding the secondary, and also an abstract of a paper on the subject of grounding presented last week by Mr. W. J. Canada before the annual convention of the Colorado Electrical Association. The first-mentioned body represents primarily the city electricians of the country and not those in charge of municipal lighting plants, as the name might seem to imply; and as the former has a prevailing voice in the formulation of municipal ordinances pertaining to electrical matters, its emphatic declaration in favor of legislation making mandatory the grounding of secondaries of 250 volts and under will most probably have important consequences. The paper by Mr. Canada embodies an able treatment of the subject of grounding, the presentation of the arguments pro and con being notably fair and judicial. It is interesting to observe the attitude of the underwriters on the subject as sketched by Mr. Canada. Beginning with hostility, after some years grounding was permitted on the score of humanity, notwithstanding the continued belief that the fire hazard would thereby be increased; finally, opinion has veered to the position—to quote Mr. C. M. Goddard—that "it is probable that the fire hazard from a grounded secondary may perhaps be less than from an ungrounded secondary." With the city electricians now arrayed in favor of grounding and a probability that the fire underwriters may in the future make the practice mandatory, the issue is becoming one which no central station can longer afford to ignore. As to the question of limiting voltage, that fixed by the American Institute of Electrical Engineers—250 volts—can, we believe, be safely accepted. To those who may consider that such a voltage is in itself dangerous to life—which opinion, we believe, has no foundation under conditions of normal health and in view of the nature of the contact apt to be made—it may be pointed out that while, to quote Mr. Canada, "We can insulate for almost perfect safety from voltages of 110 or even 220, and our new wiring insulations do this, we cannot insulate for 2200 volts, and we never attempt to do so."

Constant Current for Traction Purposes.

A paper by M. Dalemont, printed elsewhere, gives an interesting account of some recent proposals looking to constant direct-current traction system. There is, of course, nothing new in the general proposal, a system of this kind having been put into service about 20 years ago by the late Prof. S. H. Short. The scheme in its present form is worked out with considerable attention to detail and for the specific purpose of handling, not street car service as such, but somewhat heavy and long-distance traffic for which the single-phase system is now often recommended. The original Short system used practically arc machines with relatively small current. That suggested by M. Potterat is of somewhat more ambitious character, being based on the large and successful constant-current transmission systems in use on the Continent. The scheme for antomatic switching so as to maintain the motor units in series seems to have been very ingeniously worked out, and the series connection is undeniably advantageous in enabling energy to be recovered on down grades. Moreover, the control system of motors is of extreme simplicity, which is in general one of the strong points of the constant-current transmission system. The entire switchboard cost of one of the big continental transmission plants on this system is apparently only a minute fraction of the cost of the switchboard in an ordinary three-phase transmission plant as erected in this country. Nevertheless, there are objections to the series motor traction system so great that one may safely say that it will not commend itself to American engineers. In the first place, it requires the double trolley system which appears to be anathema on this continent. Second, it requires the insulation of the motor structure itself from the earth, which is an extremely troublesome matter to arrange even with large units. Third, it requires a large multiplicity of automatic switches in order to preserve connections. From the standpoint of the engineer in this country, these three objections are fatal ones; and in fact any one of them alone would be given such great weight as to forbid experiments along this particular line. Nevertheless, it is a fact that continental engineers have a somewhat shocking way of taking methods and apparatus denounced as impracticable here and making them go with distinct success. We hope M. Potterat will get the opportunity to try out this system on a reasonably large scale, and he may very possibly be able to achieve with it results which will command the respectful attention, at least, of those who are firmly set against the use of single-phase motors.

The Light of the Fire-Fly.

The recent I. E. S. paper on investigation of fire-fly light is a valuable confirmation of the previous investigations of Langley, demonstrating as it does that the peculiar spectrum

given by fire-fly light is an objective and not a subjective phenomena. Langley's investigations showed that the fire-fly which he investigated, a large West Indian species, emitted light in the form of a single diffuse band lying fairly within the region of highest luminosity. His experiments further indicated, so far as his bolometer was capable of showing the facts, that the fire-fly gave substantially no radiation outside of this somewhat limited band, with its center in the yellow-green and shading off toward the red and blue over a comparatively narrow region. The difficulty of the investigation was such and the sensitiveness of the bolometer so moderate, that the absence of other than the visual radiation was established, perhaps, by presumption rather than by accurate proof. The particular position of the visible band found by Langley, corresponding as it does very closely to the spectrum which would be expected from an extremely faint light from any ordinary continuous source, was such as to leave possible the inference that its limitations were subjective and not objective. Drs. Ives and Coblentz, taking up the investigation with a native species of fire-fly by means of a spectrograph and color sensitive plates, which, whatever their limitations of sensitiveness, certainly do not have the same limitations as the eye, have established the fact that the fire-fly light is really of the character determined by Prof. Langley. Drs. Ives and Coblentz's experiments have not extended to a search for radiation outside the limits of sensitiveness of the plates they employed, so that Langley's statement regarding the absence of other than visible radiation was not confirmed. Such confirmation is highly desirable before jumping to the conclusion that so far as perceptible radiations are concerned the fire-fly produces visible light with almost theoretical efficiency. We trust that Drs. Ives and Coblentz will find time and patience to pursue the investigations further in this direction.

During the discussion of the paper the interesting point was raised that the chemical action to which the fire-fly's light is presumably due may as a whole still be inefficient as a light producer, a portion of the energy going into complex physiological processes rather than into radiation. Even if this should prove to be the fact, it is still sufficiently remarkable that any chemical processes whatever can produce visible radiation of so extraordinary a character, uncomplicated at least by any considerable amount of invisible radiation. Inasmuch as many so-called phosphorescent bodies, like decaying wood, stale fish and meat and the like, give light apparently of similar character to that of the fire-fly, it would seem that collateral investigation of these other things might go far toward showing the process by which such light may be produced. If we remember correctly, certain luminous bacteria also give a somewhat similar distribution of light. If it should turn out that certain processes in physiological chemistry result in radiation of the general type of that of the fire-fly, a long step toward the discovery of the fire-fly's secret will have been taken. As was pointed out in the paper, fire-fly light in the raw, so to speak, would be of very objectionable color even if it could be obtained in quantity; but there seems to be some difference in the color of light given by various species of fire-flies, or perhaps by various individuals, and it is not without the bounds of possibility that some of the forms of radiation thus obtained may promise more useful color than that of the ordinary fire-fly. At all events, the subject is one that should be pursued further and is deserving of much attention from the physiological as well as the purely physical side.

Sources of Error in the Alternating-Current Wheatstone Bridge.

An article by Herr Behne, in a recent number of *Elektrotechnik und Maschinebau* and abstracted in the Digest, calls attention to a source of error in Wheatstone-Bridge measurements using alternating currents. It is shown that if this source of error is neglected the measurements may, under certain conditions, be very seriously vitiated. The error in question is due to the electrostatic capacity of different elements of the Wheatstone bridge, when used with an alternating-current source. If the potentials, with respect to ground, are materially different at different points in the bridge, dissymmetrical capacity currents will be set up, and will exercise a distorting influence upon the measuring currents. The result of the distortion, in particularly bad cases, may upset the measurement completely. This effect of capacity in the measuring apparatus, or in different parts thereof, becomes more noticeable as the frequency of the measuring alternating current is increased. At standard telephonic frequencies the effect may be very marked. In fact, bridge balances at such frequencies commonly call for electrostatic screens to be applied to the sensitive elements of the apparatus when precise measurements are required. If this precaution be not taken, the slightest working change in the dielectric medium near the instruments, such as might be due to the observer's changing his position, may have a distinct influence on the apparent measurement.

Some Errors in Testing Sources of Light.

Several recent papers on tests of light sources presented before the Illuminating Engineering Society, suggest anew some fundamental distinctions regarding the elementary geometry and physics of various sources of light. Most of the more commonly used illuminants, as the incandescent electric lamp, or the Welsbach mantle, are of such small dimensions that no appreciable error in practical work results from considering the source as a point to which the law of the inverse square of the distance applies. Such an assumption, however, applied to the calculation of the illumination produced by a tube lamp or to that produced by a skylight, or a bright wall, or even by incandescent lamps and Welsbach mantles when surrounded by reflecting and refracting shades, would frequently conduce to erroneous conclusions. Naked sources of light, stripped of all reflectors and diffusing globes, may be divided into three classes—*point*, *volume*, and *surface* sources. Elementary geometry, with the assumption of certain fundamental physical conceptions, shows the illumination from a luminous point to vary inversely as the square of the distance. Although, strictly speaking, there are no point sources in nature, the more common sources, when unaccompanied with shades and reflectors, fulfill the requirements of a point source for all ordinary practical purposes.

Volume sources are best illustrated by the Cooper Hewitt mercury-vapor lamp, or the Moore nitrogen or carbon-dioxide tube. Every infinitesimal volume of the gas is emitting luminous energy in every direction, much like a point source. But unlike a point source, there is an infinite number of these infinitesimal radiating elements which in the aggregate constitute a glowing

mass of quite large dimensions. Moreover, the radiation from one element must, in general, pass through contiguous and other elements, suffering possible absorption before it finally emerges from the tube. The application of the inverse square law to such a source, except at distances compared with which the dimensions of the tubes are negligible, would lead to erroneous results. Moreover, it is impossible to say *à priori* how the apparent candle-power of a unit length of such a tube would vary with the angle of emission in any plane of the tube. If there were no absorption by one element of volume of the transmitted luminous energy from another radiating element back further in the line of sight, the apparent candle-power would be the same in every direction. If, on the other hand, the absorption were so great that practically all the energy which was emitted by a unit length of the tube came from the elements lying on the surface of the cylinder, the apparent candle-power in any direction in a plane of the tube would be approximately proportional to the cosine of the angle between the given direction and the normal to the tube, the distribution being thus the same as that from a solid cylindrical radiating surface. As a matter of fact, as shown in the tests referred to above, in the actual case of a tube, the distribution of flux is much more nearly that from a non-absorbing gas than from an almost completely absorbing gas such as would give a cosine distribution. The apparent candle-power at increasing angles to the normal decreases relatively little, indicating some, but no great, absorption. This same general conclusion may be reached qualitatively by noting the bull's-eye effect on looking into an end of a tube light as at a bend or corner.

In a surface source of light all the radiation comes from the superficial elements of volume, as in the case of a completely absorbing gas. The intensity in any direction of an infinitesimal element of surface having the characteristics of a black body is proportional to the cosine of the angle between the given direction and the normal to the surface. Since no material substances are absolutely black, and no sources are, strictly speaking, of infinitesimal dimensions, the cosine law of emission is never realized in practical cases. Even neglecting the deviations from blackness, the problem of computing the distribution of illumination from extended surface sources, such as skylights, or bright walls, is not a simple one. Unfortunately, these fundamental distinctions have been completely overlooked in some of the current literature on this subject; and these omissions, together with an evident ignorance of the application of mathematics to physical problems, account for the remarkable results of some of the published theoretical investigations of light sources.

Third Harmonic Frequency E.M.Fs. in Three-Phase Alternators.

In single-phase alternators, having a single-path armature winding, the voltage at the terminals contains, in general, all of the harmonic frequencies that are developed in the individual copper bars or armature-conductors. It is possible, in a slot-wound armature, to have such a distribution of slots with respect to the pole that some particular harmonic frequency, or set of harmonic frequencies, may disappear in the resultant; but, in general, if harmonics are present in the e.m.f. wave of each individual conductor they will also be present in the open-circuit e.m.f. of the armature winding, after being connected up single-phase. When, however, three equally interspersed armature windings are arranged to form a three-phase armature there will be no triple-frequency harmonic e.m.f. presented at the armature terminals, nor any harmonic frequency in the terminal e.m.f. that is a multiple of three. This statement may be condensed into the proposition that no three-phase winding can deliver triplicate-frequency harmonic e.m.fs. It is assumed in this proposition that the slots are symmetrically spaced in the armature body, which is to say that the armature is correctly machined; but no reservation has to be made as to the connection of the armature, whether in star or in delta. The triplicate-frequency harmonics all vanish from the terminal e.m.fs. of a three-phase armature, whether delta-wound or star-wound. Consequently, since the triple-frequency harmonic is the first on the list in the rising order of harmonics, and since it is commonly the largest in amplitude, its elimination from the terminal e.m.fs. of three-phase machines often gives to the terminal e.m.fs. an approach to the sinusoidal wave-form that the individual copper bar e.m.fs. do not enjoy. The terminal e.m.fs. of a three-phase alternator thus often assume a degree of virtue, in respect to sine-wave form, that the individual bar e.m.fs. never attain; so that the motto of a three-phase winding might well be that in union lies virtue as well as strength.

We print this week two articles bearing on the above subject, by Mr. F. M. Denton and Mr. Shiro Sano, respectively. The former writer deals with the question from an oscillographic point of view, and the latter from an algebraic point of view. The oscillographic method has the advantage of resting upon, and resorting to, concrete impressions visualized from the photographic record. The algebraic method has the advantages of compactness and generality, but for those very reasons requires to be handled with greater caution to avoid pitfalls in deduction. The oscillographs accompanying Mr. Denton's paper are very interesting. The machine whose e.m.f. wave performance is there presented evidently had a marked triple-frequency e.m.f. harmonic—14 per cent of the fundamental in amplitude—so that the influence of the three-phase delta or star connection are clearly brought out. Fig. 14 indicates that the individual bar e.m.f. in this machine is kinkier than the e.m.f. of one phase winding with its 16 slots. In other words, the vector summation of the individual slot e.m.fs. has the effect of reducing all of the harmonic frequencies, and particularly the fifth-frequency harmonic e.m.f. The table indicates that whereas the fifth-frequency harmonic in each individual bar had an amplitude of 7.4 per cent of the fundamental, yet when all the bars of one phase winding are connected in series the vector summation brings down the fifth-frequency harmonic in the resultant phase e.m.f. to 1.4 per cent of the fundamental. When, however, the star-connection of the three phases is completed the terminal e.m.f. is nearly sinusoidal, there being only a 3.4 per cent quintuple-frequency ripple discernible in it, with only vestiges of other harmonics. The triple-frequency harmonics, present in each phase, has been nearly wiped out, and theoretically should have been completely wiped out. It is also interesting to see in the oscillographs that whereas the individual phase-winding e.m.fs. of the machine are dromedary-backed waves, or peaked waves of one hump, the open-delta

connection, such as might result by the disuse of one side of this armature, if delta-connected, produces camel-backed waves, or waves of two humps.

The Denton article contains a plea for star-wound armatures in three-phasers, as contrasted with delta-wound armatures. This is sound, provided the star-wound armatures have no grounded neutral point. If there be a grounded neutral point then it is well known that triple-frequency charging currents may manifest themselves in the cables connected to the machine. In considering the argument, however, in favor of star-winding versus delta-winding, it should be borne in mind that designers take care to reduce the triple-harmonic frequency e.m.f. in the bars of delta-wound armatures, whereas they usually omit this precaution in star-wound armatures without neutral connection. Consequently, while there may be some parasitic current and power waste in delta-wound machines, due to triple-frequency currents, yet it is not large in well designed armatures. The Sano article seems to develop a fallacy in one particular, if we understand its conclusions correctly. The algebraic reasoning appears to be sound, but the deduction from it at the last moment is open to adverse criticism. The delta-connected armature is shown to constitute a complete short-circuit for triple-frequency harmonic e.m.fs. The drop of pressure in each phase-winding, due to the short circuit triple-frequency current, is exactly equal to the triple-frequency voltage generated in the same. But the drop of pressure is opposite in direction to the said internally generated e.m.f., and consequently the latter is cancelled and destroyed, thus purifying the terminal voltage wave-form; whereas, it would seem that, according to the Sano article, the delta connection does not cause the terminal voltage to differ in wave-form from the phase-winding voltage.

International Electrical Standardization.

Among the papers presented before the recent British Association convention at Winnipeg is one by Mr. Ormond Higman on "International Electrical Standardization." This is a careful, full and nearly complete statement of the history and objects of the international electrotechnical commission since its inception. It may here be pointed out that the recommendation by the St. Louis International Electrical Congress, which led to the formation of this commission and also to the holding of regular conferences by Government representatives on questions relating to units, had its origin in the feeling that the Chamber of Delegates at international electrical expositions, which previously had considered matters relating to units and standards, had outlived its usefulness, and that the work of which it had taken cognizance should properly devolve on two permanent bodies, one to represent electrical engineering and the other to deal with questions involving Governmental approval. The plan for the formation of the two bodies when first broached met strongest favor with the foreign delegates to the St. Louis Chamber of Delegates, but it was finally presented as an American proposition. The Electrotechnical Commission has now been in existence for three years, and thus far it has only accomplished one piece of work, namely, the adoption of the international candle between England, France and America, with probably other endorsing countries to follow before long. But whether other countries formally endorse the action or not, the benefit obtained by the action has already been very marked in regard to the photometry and photometrical literature of the three co-operating countries. This successful piece of work would alone be sufficient to justify the existence and organization of the commission. It is, however, to be hoped that other practical accomplishments will steadily follow. There is much to be done, and while the American Institute of Electrical Engineers has thus far merely contributed to the financial support of the commission, it could, if it would, become a powerful factor in extending the usefulness of the body.

One of the important fields of work before the commission is the adoption of an international set of standardization rules. Such rules should control the specifications of electrical machinery in all countries. They should not go too far, and certainly not too far at the outset. Their initial province, as we conceive it, would be to define electric machinery and apparatus in such a manner that the title and definition of a certain electric machine, say, a direct-current motor, shall be the same in any or all civilized countries, and not be a function of geographical co-ordinates—one thing in one country and another in another. At present such a thing as, say, a 10-kw direct-current mtor is more or less a function of geographical co-ordinates, and so are, *a fortiori,* such things as a 10-kw direct-current series motor, a 10-kw direct-current shunt motor, a 10-kw direct-current intermittent-service motor, etc. The geographical differences are at present not merely in respect to definition of function, but also in respect to definition of capabilities, as determinable by tests of heating, overload, dielectric strength, etc. By reason of differences in requirements under the standardization tests of different countries, a 10-kw direct-current intermittent-service hoist motor, in its land of birth, might possibly be a 5-kw machine in a second country and a 15-kw machine in a third.

It is true that in order to arrive gradually at such a set of international standardization rules, it is necessary carefully to define the meanings of corresponding terms and names of machinery and apparatus as they exist in different languages. But it is, we think, an error to infer that, on this account, we need a whole glossary. An international glossary of electrical terms is no doubt a good thing, but it is of secondary importance to standardization. To construct an international glossary ahead of an international standardization is to put the cart before the horse. What is wanted is a start on standardization, and when the international standardization committee meets terms that are not clearly equivalent in the different languages it must pause to settle the definition of those terms. In this way there will be the minimum waste of labor on purely philological lines and the international glossary of words will grow *pari passu* with the international agreement upon things and physical actions. Another important duty before the commission is the gradual adoption of an international code of symbols for electrical engineering quantities in literature, so that when engineers discuss such fundamental things as e.m.f., current, resistance, power, etc., in equations the letters used to designate these various quantities shall be, as far as possible, the same. To complete this work may take many years, but there is no reason why it should not be started upon advantageously forthwith. The unifying power of an international table of symbols to bring engineers' writings into conformity increase, like a rolling snowball, at compound interest.

Autumn Meeting of the American Electrochemical Society.

The autumn meeting of the American Electrochemical Society will be held in New York City, Thursday to Saturday, Oct. 28 to 30. The convention will be opened by a professional meeting in the Chemists' Club in the afternoon of Thursday. Besides a number of papers to be presented and discussed there will be an experimental lecture by Prof. Edgar F. Smith, of the University of Pennsylvania, on recent developments in electro-analysis. On Saturday morning and afternoon, two sessions devoted to the reading and discussion of papers will be held at Columbia University.

The whole of Friday will be devoted to an excursion to Bayonne, N. J. Members and guests will meet in the waiting-room of the station of the Central Railroad of New Jersey in Jersey City, at 8:30 a. m. A special train will take the party to the Constable Hook section in Bayonne, where the forenoon will be spent. In the afternoon, plants in the Newark Bay section of Bayonne will be visited. At noon a lunch will be served at one of the shore resorts on the Kill von Kull. The Mayor of Bayonne, Hon. Pierre P. Garven, will there welcome the Society to Bayonne.

So far the following companies have given permission to visit their plants: Standard Oil Company, National Sulphur Company (refining of sulphur); Pacific Coast Borax Company (manufacture of borax and boric acid); Gröndal briquetting plant at the works of the General Chemical Company (this is the first American installation of the Gröndal process for briquetting ore, etc.); Babcock & Wilcox Company (water-tube boilers and adjuncts); Electro-Dynamic Company (interpole motors for wide-speed variation); Electric Launch Company (submarine vessels, etc.); Industrial Oxygen Company (oxy-acetylene welding and cutting apparatus).

While the above-named companies have given permission to the society as a whole to visit their works, it is under the condition that members interested in a process are expected not to visit a competitive plant. Thus, the Standard Oil Company has given permission under the condition that no one connected with the refining of oil will be allowed to visit its works. Similar conditions have been made by the Babcock & Wilcox Company and the National Sulphur Company. The different plants to be visited are, however, of such a diversified character that every member will find enough of interest to take part in the excursion. The party will return to New York by special train.

In the evening of Friday a banquet will be held at the Hotel Cumberland. On the evening of Saturday the society will be the guest of the New York Chemists' Club at a smoker in their club house. Arrangements are being made for the entertainment of visiting ladies.

Dr. Leo. H. Baekeland is president of the society and Dr. J. W. Richards, Lehigh University, South Bethlehem, Pa., is the secretary. In order to make detail arrangements for the special train and lunch on Friday members who wish to participate in the excursion should send early notice to Dr. Richards.

Grounding of the Secondary Endorsed by the Association of Municipal Electricians.

At the recent annual meeting of the International Association of Municipal Electricians the following resolution in favor of grounding the secondary was adopted:

"*Whereas,* one of the purposes of the International Association of Municipal Electricians is the protection of the lives and property of the people whom we represent from electrical hazards; and

"*Whereas,* alarming destruction of life and property has resulted from high voltages on alternating-current secondary systems by reason of the failure of the insulation between the primary and secondary circuits of such systems; and

"*Whereas,* the existence of the said high voltages may be prevented by properly grounding the alternating-current secondary systems;

"*Now, therefore, be it resolved* that the International Association of Municipal Electricians, deliberating as an international body, urges and demands the enactment of proper legislation requiring the grounding of all alternating-current secondary systems, when by so doing the voltage between the earth and any part of the said secondary system will not exceed 250 volts; and this body pledges the support and advocacy by its members of all legislative measures to that end."

A lengthy discussion preceded the adoption of the resolution. One member referred to a number of serious accidents within his knowledge which occurred from contact with ungrounded secondaries, due to a cross with a high-potential circuit or to a defect in a transformer. He also mentioned a case where a man died from electric shock, but investigation did not reveal any defect in the secondary; upon a post-mortem examination, however, the physician found that man's heart was in such a condition, he said, even a slap on the face would perhaps have been sufficient to cause death. Another member said that in the course of a conversation on grounding with the superintendent of a large central-station company, the latter said that to ground the secondary would involve an expense to his company of from $15,000 to $20,000, and, although personally, "as man to man, I believe it is a good thing, there is the expense."

Referring to a statement that the matter of grounding the secondary was a life hazard and not a fire hazard, a member said he finds that many underwriters' inspectors agree that an ungrounded secondary is a fire hazard as well as a life hazard. A member asserted that many fires have, in fact, occurred from ungrounded secondaries, and that the expense from burned-out transformers is the reason why electric lighting companies do not want to adopt grounding. One central-station manager, however, had remarked to him that the loss of a few transformers is not as bad as the loss of a few lives. "We want to ground our secondaries because if we do not we will have some accident, and we will suffer more through damage suits than by the destruction of transformers by lightning or any other way." The same member remarked that the experience of the average inspector of fires is that nine out of every ten electrical fires are caused by a leaky transformer. In a particular case where the central station was much opposed to the grounding of secondaries he said he found that this company had two cases in court, one of a man killed and the other of a man injured from coming in contact with a secondary that had been crossed with a primary. There was some discussion as to the character of the grounds, and a suggestion was made that there should be a specification to cover this, but no action was taken.

Honorary Commercial Commissioners of Japan at Schenectady.

On Monday, Oct. 11, the party of 58 Japanese, including 6 women and 13 secretaries, and American representatives of the Government and various cities, arrived in Schenectady in their special train. The special train carrying the party was shifted into the General Electric Company's yards about 9 o'clock, and the party was escorted to one of the reception headquarters, where introductions were made to the officials of the company and civic officials of Schenectady.

A comprehensive tour of the factories was then made in which the party was divided in groups, each accompanied by interpreters and guides. An informal luncheon was served to the visitors and company representatives, totaling 125, in the new factory restaurant, which is a new concrete building with modern facilities for serving large numbers of employees daily. At this luncheon the visitors were welcomed by vice-president E. W. Rice, Jr., who referred to the international significance of the tour as indicating better relations between the two nations due to the opportunities it afforded for observation of indus-

trial methods and commercial conditions in this country, as well as the personal acquaintances made by the visitors with American business men. He called attention to the fact that as large as the Schenectady plant is it was but one of the General Electric Company's factories, representing about 60 per cent of the manufacturing facilities of the company. Brief acknowledgment was made by Baron Shibusawa, chairman of the commission, in which he proposed a toast to America and the General Electric Company, which was heartily responded to by the visitors and followed by "Banzai."

The ladies of the party meantime were entertained at the home of Vice-President Hinsdill Parsons at luncheon and later joined the party in a tour of Schenectady in automobiles in which was included a visit to Union College campus, where the American game of football was demonstrated by two of the college elevens.

In the evening at the Mohawk Golf Club the entire party of commissioners was entertained by the General Electric Company at a dinner attended by prominent officials of the company and a few invited guests.

Wireless Institute Meeting.

At a meeting of the Wireless Institute, held in the Engineering Societies Building, New York, on Oct. 6, a paper having the title "Proportioning Transmitter to Aerial" was presented by Mr. F. W. Midgley. The author reported the results of experimental observations to show the ratio between the natural wave-length of the aerial circuit and the length of the aerial itself. This ratio has a value varying from below 4 to above 5, being greater for a straight vertical wire and less for a wire turned back upon itself or having a horizontal section. A good average value for the ratio is 4.4.

It is evident that for most effective transmission the signals should be propagated at a wave-length corresponding to the natural wave-length of the aerial or 4.4 times the length of the aerial. This relation fixes at once the desirable transmission frequency. Since in any resonating circuit the frequency is $f = 1 \div 2\pi\sqrt{LC}$, the product of L and C—that is, of the inductance and capacity—is set by the length of the aerial. The aerial itself possesses a certain amount of inductance, which may be considered the minimum permissible value for L, indicating thereby a certain maximum value for C. Now, with a certain value of capacity there is a definite length of spark-gap for best operation, and for each length of spark-gap there is required a definite voltage. A definite voltage at a definite frequency impressed across a condenser of a certain capacity requires a definite amount of volt-amperes. In this manner it was shown that for each arrangement of aerial there is a best value for the input power, which value increases with the increase in wave-length, and in many cases is much less than the value actually employed with the wave-length selected for transmission.

Wisconsin Water-Power Court Decision.

A decision most important to the development of unused water-power in the State of Wisconsin has just been handed down by the State Supreme Court. It was pointed out in the decision that the State Legislature has the right to grant a franchise for the construction of a dam across the Wisconsin River, giving the grantee the right of eminent domain in the matter of condemning lands necessary for flowage purposes.

Some time ago the Southern Wisconsin Power Company was given a franchise by the Legislature to construct a dam across the Wisconsin River, which was recently completed at Kilbourn. The owner of a small tract of land bordering the river, and a land company which, just before condemnation, bought up land which would be flooded, instituted proceedings against the franchise. The Southern Wisconsin Power Company won its case in the Circuit Court, but the defendants appealed to the State Supreme Court. It was contended that the Legislature had no right to authorize the construction of a dam across the Wisconsin River, because the Constitution of the State, as well as an ordinance, provided that all navigable waters leading into the Mississippi River should be common highways and forever free to the inhabitants of the State and the United States without tax, impost of duty therefor, and that this provision related to physical obstructions in the stream.

The court holds that the Legislature has absolute power to grant the right to construct such dams, subject only to the right of the United States Government to interfere under the commerce clause of the United States Constitution and take charge of the navigable waters of Wisconsin. The court said that the Federal Government had consented to the construction of a dam across the Wisconsin River at Kilbourn. In reply to the contention that the clause of State Constitution quoted by the defendants related to physical obstructions in a navigable stream, the court holds that the clause does not relate to physical obstruction. This decision is in harmony with repeated decisions of the United States Supreme Court on the same question.

Another contention was that the real motive for the construction of the dam was the generation of power, and that this was not a public but a private use. The court holds that the generation of hydraulic power for public purposes is a public use and the generation of such power authorizes the taking of private property by the right of eminent domain. The court also held that the franchise was granted to the Southern Wisconsin Power Company for the purpose of improving navigation, and that this was accomplished, and that the dam in no way interfered with navigation. The lake created by the dam made navigable many parts of the famous Dells of the Wisconsin River heretofore unsafe for rowboats and launches and greatly improved their scenic beauty, instead of ruining it, as was feared would be done. It is stated that the Southern Wisconsin Power Company intends to erect another large dam across the Wisconsin River at Prairie du Sac.

Worcester Electric Light Situation.

The protective committee of the board of directors of the Worcester (Mass.) Electric Light Company has announced in a circular to stockholders that it has secured control of a majority of the company's stock, and it asks all the remaining holders of shares to place their stock in the committee's hands for 60 days, beginning Oct. 1, with full authorization for the committee to act as trustees on behalf of the stockholders and sell or transfer the shares to such parties and at such prices and terms as the committee may deem for the best interests of the shareholders. The committee binds itself not to sell any shares at less than $300 each, and not to sell any of the shares unless it sells all the shares thus placed in its hands. Unsold shares will be returned in 60 days. It is pointed out that the committee desires the stockholders all to be upon the same basis in regard to any advantageous dealings that may occur. The circular is signed by President Augustus B. R. Sprague, and Messrs. A. George Bullock, Matthew J. Whittall, Francis H. Dewey and John C. MacInnes, all of Worcester. The annual meeting of the company will take place at the Faraday Street offices in Worcester on the afternoon of Oct. 13, and it is expected that the whole situation with respect to the possible sale of the company or the continuance of the present owenership will be thoroughly considered. Little has been heard in Worcester during the past week of the plans of the proposed holding company, and it is not regarded as probable that the property will pass into the hands of the Kinnicutt-Rice-Gage interests. It is understood that the offer of Stone & Webster of $300 per share for a majority interest in the property still holds good, but it is not known to what extent this has been embraced by individual stockholders. Some of the company's officers have intimated that a new generating station may ultimately be built in Worcester on a site having better water and coal-handling facilities than the present plant, but this more or less tentative proposal is merely incidental to the broad policy of commercial expansion which the company anticipates if allowed to develop along proper lines.

Central Station Statistics.

The Lighting and Power edition of the *McGraw Electrical Directory*, now on the press, lists 221 central station companies not previously reported. This makes a present total of 5908 companies and municipal plants in the United States and Canada. The total for Canada is 413. The April issue of the *Directory* gave a total of 5740 plants, the net gain thus being 168 plants, with 53 dropped out through consolidation, sale or other cause. Out of this total of 5908, 3295 companies have reported that they carry electrical supplies. The number of plants supplying direct current remains the same, namely 1669, while those supplying alternating current have increased from 4164 to 4266. There are 147 companies doing a purely transmission business, while 674 others combine local with transmission or traction work. The total number of municipal plants reported in the United States is 1233, an increase of 12 over the number reported in the April issue. The *Directory* also gives the data of 67 Mexican plants.

British Welsbach Tungsten-Lamp Campaign.

By Glenn Marston.

The electrical industry in England has not been so stirred for years as by the recent announcement of the Welsbach Company that hereafter it would deal in metallic filament electric lamps in addition to its extensive trade in gas appliances. It is taken to indicate in many quarters that the gas interests recognize the inevitable replacement of incandescent gas by metallic filament electric lamps.

Press comment on the innovation, particularly among technical papers, is very free, the electrical publications assuming a more or less patronizing air toward gas. The announcement was first blazoned forth in the daily papers of Sept. 23, all the leading metropolitan sheets carrying full-page announcements, including a cartoon. Since then the same advertisement has appeared in the electrical papers, and six-sheet posters are going up all over London portraying the same illustration with condensed reading matter. In some cases these posters appear on the same billboards with advertisements of Welsbach mantles.

The Welsbach Company breaks the news as gently as possible in the press matter sent out with the advertisements. One paragraph of the company's statement reads: "As a business move there can be no question of the soundness of the Welsbach policy, because, while there is not, and cannot be, any suggestion that electricity is as yet anything like so cheap as incandescent gas, still the Welsbach is a business company, and there are factors other than cheapness to be taken into consideration, notably the greater cleanliness of electric light." The electrical papers consider this to be mere babble.

One electrical journal expresses the opinion that the introduction of the Welsbach tungsten will be a severe blow to the gas business. "The name of Welsbach has so long been associated with gas alone that the public will wonder at their expansion into the electric business," it said. "The offer of the Welsbach people will result in giving away a great many lamps, for it will encourage the consumption of electricity. The householder who tries Welsbach tungstens will be extravagant in his use of energy, and it is well known that no customer, once he has benefited by a generous use of artificial light, allows his illumination to be curtailed."

"It is an admission on the part of the gas people," says another electrical journal, "that metallic filament lamps will cut deeply into the popularity of incandescent gas. It is a step in the direction of self-protection. As the use of gas mantles diminishes the Welsbach Company will be ready to supply the tungstens to supplant them."

One of the most prominent light and traction men of the British Empire, whose interests are spread over the whole world, spoke as follows: "The effect of the Welsbach Company's entrance into the electrical field will be of little consequence. There is already very hot competition in the sale of tungsten lamps, and one manufacturer more or less will hardly be noticed. On the other hand, it furnishes the electricity supply people with an almost unanswerable argument in favor of electricity as against gas, and I shall be interested to see what they make of the opportunity."

A member of the staff of the *Times* felt that the electricity supply companies would attack with renewed vigor the problem of preventing further inroads into the lighting business by the gas companies. As a general thing the electric plants have not been favorable to the introduction of tungstens, and have made little effort to build up their load which has been lost through customers' use of metallic filament lamps. They have been content to speak deprecatingly of gas and let it go at that. It seems very probable now, however, that they will learn their lesson from the gas man and go into tungsten lighting on a much larger scale.

The problem of the tungsten lamp has been a serious one here—more serious by far than in America. The cost of running services is high and an income of £2 a year does not make a profitable customer. A new rate was under discussion at a directors' meeting of an important group of companies which is practically a reversion to the old flat rate. The minimum charge is based on an installation of 10 lamps with a certain number of hours' burning. When this has been consumed, excess energy is charged at existing maximum meter rates. The low power consumption of metallic filament lamps will make it a rare occurrence for the customer to exceed his minimum rate. It is said that an attempt will be made to get the Board of Trade to recognize new rates based on lamp hours instead of on energy consumption as at present.

Baltimore Gives Contract for Naphtha Street Lamps.

At a meeting on Oct. 6 of the Baltimore City Board of Awards a contract for naphtha lamps for the lighting of streets was awarded to the American Street Lighting Company, of Baltimore. Mr. Robert J. McCuen, superintendent of the Department of Lamps and Lighting, together with several members of the board, were decidedly in favor of lighting the streets with incandescent lamps. Had the board been willing to consider electric lighting on a three-year basis the price would have then been cheaper than that of the other bids which were submitted for street lighting.

For quite a while it appeared as if the incandescent system would win out, as Mr. McCuen reported that more than 5000 fines had been levied against the American Street Lighting Company by reason of naphtha lamps not being lighted or going out during nights, but rather than make a long-term contract the board finally agreed on naphtha lamps. An attempt was made by the attorneys for the American Company to show that incandescent electric lamps were in a purely experimental stage, so far as municipal street lighting was concerned, but this contention of lawyers apparently made no impression on the board.

Electrical Development in Mexico.

The Guanajuato Power & Electric Company, which is making large additions to its hydroelectric plant in the vicinity of El Duro, State of Michoacan, is preparing to broaden greatly its system of transmission lines. It already furnishes electric energy for a number of towns, mining camps and industrial centers within a radius of 120 miles of El Duro, among them being Guanajuato, Irapuato, Leon, La Parca and several smaller places. It is now proposed to extend the Leon transmission line to Aguas Calientes, a distance of about 100 miles. Aguas Calientes is one of the chief manufacturing cities of Mexico. The situation there was recently investigated by Mr. Norman Rowe, manager of the company, and plans are being made to have the transmission line extended to that place by next June. The company will soon have 20,000 hp at its disposal. At present there are two electric power and light companies in

operation at Aguas Calientes. Negotiations are pending for the purchase of the holdings of these two concerns by the Guanajuato Power & Electric Company. The smelter at that place is one of the largest in Mexico. It will obtain its electrical energy from the invading company as soon as the transmission line is finished. The new line will deliver electrical energy to a number of towns situated between Léon and Aguas Calientes.

At a recent meeting of the stockholders of the Mexican Northern Power Company held at Montreal, Canada, it was decided to let immediately the contract for the construction of the great dam across the Conchos River, 17 miles above Santa Rosalia, State of Chihuahua. This dam will form the water reservoir which will furnish the initial power for the hydroelectric plant. It is estimated by engineers who have reported on the project that 40,000 hp can be generated at the site selected for the dam. Considerable preliminary work has been done at the site of the proposed dam. In addition to furnishing power for operating the hydroelectric plant, the reservoir will afford a water supply for irrigating 200,000 acres of rich valley land which the company owns. The mining and industrial interests of that part of Mexico are elated over the prospects of the early consummation of the big enterprise. The electric energy will be transmitted to mining camps, towns and industrial centers situated within a radius of 150 miles, and will greatly lessen the cost of operating various kinds of enterprises.

Mr. S. W. Elkens, who is said to represent a syndicate of Canadians, has been investigating the situation at Durango with a view to installing a large electric light and power plant there and constructing a system of electric railway over a number of the streets of the city. It is reported that he is negotiating for the purchase of the electric light and power plant now operated there, and that if this deal is consummated the plant will be greatly enlarged.

Manuel Tamborel, of Mexico City, is preparing to install a hydroelectric plant on the Conchos River, State of Chihuahua. He has obtained a concession from the Federal Government for the purpose.

Jose Diaz Rubin, of Puebla City, will install a hydroelectric plant on the Nexapa River, State of Puebla. He will furnish electric energy to a number of industrial concerns. He lives at Puebla.

The introduction of electricity for operating the machinery and reduction mills of mining concerns in the Etzatlan and a number of other mining districts in the State of Jalisco will be accomplished about Jan. 1 by the Chapala Hydro-Electric & Irrigation Company, of Guadalajara. The hydroelectric plant and transmission lines are now being constructed. A number of the larger mining companies have contracted for electrical equipment for their respective properties, among them being the Amparo Mining Company, which has placed orders for $25,000 worth of electrical machinery, and contracted to take up 700 hp from the electric company. The fuel bill of the Amparo Mining Company now amounts to $100,000 per annum. With the introduction of electrical energy the amount will be reduced to $70,000 per annum and the power doubled.

The Hidalgo Cement Company is preparing to erect a hydroelectric plant on the Montezuma River, about three miles south of Dublan, State of Hidalgo, where its cement works and headquarters are situated. A large reservoir will be formed by the construction of a dam across the river, which will cost about $500,000. The hydroelectric plant will have a capacity of 1200 hp and will cost about $200,000 to erect. The surplus water will be used to irrigate a large tract of land. The electric energy will be used to operate the machinery and furnish lighting for the cement plant.

A large hydroelectric plant will be erected at the waterfall of El Salto, situated 50 miles west of Durango, by Charles von Brandis, of that city, who has obtained a concession from the Federal Government for the proposed enterprise. The electric energy will be transmitted to Durango and a number of mining camps in that State.

The concession which the Government granted four years ago for the construction of an electric railway between Autlan and the Pacific port of Chamela, a distance of about 200 miles, will expire Nov. 1, after being extended one month. The concession is owned by L. O. Harnecker. It is reported that a syndicate of Germans is investigating the situation with a view of taking over the concession and building the proposed road.

Proposed Arizona Hydroelectric Plant.

A syndicate of Denver and Colorado Springs capitalists have under consideration a project to build a dam across the Gila River, 14 miles below San Carlos, and establish a system of irrigating canals and ditches and a hydroelectric plant at an estimated cost of more than $1,000,000. This reservoir site was formerly controlled by the Federal Government, but was abandoned several years ago, the property passing into the hands of William Sparks. Recently Roy Davidson, acting as representative of a number of Denver and Colorado Springs men, obtained an option to purchase the property from Mr. Sparks. The proposed reservoir will furnish a water supply sufficient to irrigate 200,000 acres of land. The hydroelectric plant will transmit electricity to towns and mining camps in the surrounding territory.

Underground Wires in San Francisco and Oakland.

The Electricity Committee of the Board of Supervisors of San Francisco will recommend shortly that wires for electric light and power purposes must be encased in conduits when entering buildings within the fire limits. The needs of this protection was called to the attention of the committee by the Electrical Contractors' Association, which set forth that in all large cities there exists such ordinances, but in San Francisco the question has never been considered. The association wanted telegraph, telephone and signal wires included in the ordinance, but it was thought not necessary to impose this additional expense upon the companies when there was really no need for it. A committee, composed of Chief Nizon, of the Electricity Commission; Chief Inspector Horgan, of the Board of Public Works, and a member of the association, to be named by the president, were empowered to frame an ordinance along the lines indicated.

The second extension of the underground wire district in Oakland, Cal., has been recommended by the Board of Public Works, of that city, in a resolution to the City Council, asking that an ordinance be framed and passed to effect the extension. Overhead telephone, telegraph and electric light wires have already been taken off the main business streets. The proposed district for underground wires will run out Broadway to Piedmont Avenue, thence extending out Piedmont Avenue to the city line. The removal of the wires in Piedmont Avenue was commenced some time ago under an agreement with the gas, telephone and telegraph companies. In Twelfth Street and East Twelfth Street, if the desired ordinance is passed, the overhead wires will be removed as far east as First Avenue. The present underground wire district is to be extended from its present northern limit to Twenty-second Street in both Broadway and San Puebla Avenue.

Reminiscences of Early Electrical Days.

Following the regular weekly luncheon of the Chicago Electric Club, in the Grill Room of the Chicago Automobile Club, on Wednesday, Oct. 6, Mr. Foree Bain, patent attorney and electrical expert, entertained the club with an interesting address entitled, "In the Early Days of Electrical Development."

Mr. Bain carried his listeners back to the time of the Civil War, when, as a boy, his ambition in life was to become a telegraph operator. He related how, when at school, he fitted up a crude telegraph instrument, made of wooden levers, and con-

nected it to a companion's desk by means of twine, and when later on he became old enough to be considered seriously as an operator and wanted to practice, how he constructed an instrument, using a Daniels' cell, old zinc from scrap heaps and iron wire.

Mr. Bain's first invention, a self-closing telegraph key, was made during the time he was employed as an operator on a Southern railroad. It consisted of a treadle located under the operator's bench and connected by means of hand-made levers. One night a dog came into the office and went to sleep on the treadle, thus putting the invention out of commission and ending the dream of the inventor. Mr. Bain later became interested in telephony and constructed the first telephone he ever saw. Subsequently he obtained a position as salesman for the Post Manufacturing Company, soliciting subscriptions and making his own installations.

A number of interesting experiences regarding incandescent lamp installations were related. A lighting plant having been installed in a hotel by Mr. Bain in those days, the guests spent the night in celebration of the event. Incidentally they could not sleep on account of the noise made by the generating units.

A few years later Mr. Bain was appointed electrical engineer of the Minneapolis Electric Railways, his duties being to install an electric traction system in St. Paul and Minneapolis. The difficulties encountered in this installation were many. The city ordinance of Minneapolis provided that on certain streets all electrical conductors must be placed underground, and to comply with this ordinance, Mr. Bain had to do considerable traveling in order to purchase the necessary materials. Probably the most interesting feature of this installation was the manner in which the conductor was laid under ground. A number of pasteboard tubes, heavily insulated, were first laid. The question then was, how to get the conductor through the tubes? To accomplish this a contrivance resembling the thumb of a glove was fastened to the end of a cord, and with the aid of a blower this arrangement was shot through the tubes, and later a cord fastened to the conductor and drawn through. Other difficulties met with in this installation were the fitting up and installing of new generating units. The speaker related a number of similar amusing experiences, and told of the many difficulties encountered by electrical men in the early days of electrical development.

Proposed Baltimore Municipal Lighting Plant

The Maryland Legislature in 1900 gave to the city of Baltimore authority to establish and maintain a municipal electric lighting plant, and further authorized the submission to the people of a loan of $1,350,000 for that purpose, which can be done at any time. The project for such a plant has recently been revived owing to the recent consolidation in that city of electric lighting properties which, it is asserted, removes all competition for street lighting by electricity. The Mayor has requested the superintendent of lamps and lighting to make an investigation and report whether the garbage-reduction plant, located at Fort Covington, is suitable for electrical generation. It is said that the report will state that the building was found well fitted to be converted into a lighting plant. It is located directly on the water front, where coal for the steam plant could be readily and easily obtained. The superintendent will, it is said, also report that the loan authorized in 1900 is adequate for the purpose of establishing such a plant, and that a lesser appropriation than the $152,640, now made annually for electric lighting, will not only maintain the plant, but will also furnish the lamps needed, pay the interest on the loan and provide a sinking fund to take care of the principal, and further defray the loss to the city from shrinkage in duct rentals and easement tax as a result of such a change.

It may be determined to ask for bids on the municipal lighting early next year, in order to have the plant in operation by September, when the present contract for electric street lighting expires.

Disturbances to Telephone and Telegraph Systems.

A paper entitled "Telegraph and Telephone Systems as Affected by Alternating-Current Lines" was presented by Mr. J. B. Taylor before the American Institute of Electrical Engineers in New York on Oct. 8. The author outlined the characteristic features of telephone and telegraph systems and explained the disturbances caused by alternating-current energy transmission systems operating in their neighborhood. He remarked that all working conductors are surrounded by electromagnetic and electrostatic fields. These fields induce e.m.fs. and charges in neighboring conductors. With an ideal metallic circuit, external fields are a minimum; similarly, an ideal metallic circuit may be in fields of any strength without being disturbed. Practical considerations prevent these ideal conditions from being realized. Hence currents will be induced in any closed-circuit conductors wherever placed as a result of currents and potentials on other conductors. Disturbance results only when these induced currents are of sufficient magnitude to be objectionable.

Commercial telephone lines have little margin to meet disturbing conditions more severe than normal. An increase of telephone currents to three or four times their present values would doubtless result in great disturbance to other wires in the same telephone system and require new standards of construction and maintenance. The same statement applies to telegraph systems. Theoretically a balanced telephone line can be operated in proximity to alternating-current wires. This is not true of a telegraph line, as there is no way of balancing a circuit using earth return. Where trouble is experienced on a telephone line it may be possible to clear same by putting the system in first-class condition. Where trouble is experienced on a telegraph line, some change in the apparatus or circuit arrangements will be necessary. For any given case, all the features of the energy transmission system and signaling system should be taken into account with a view to arriving at the proper procedure to reduce or to eliminate the disturbances.

In the discussion of Mr. Taylor's paper, Mr. C. F. Scott stated that the disturbances to signaling systems caused by energy-transmission systems can be grouped into three classes, namely, leakage, magnetic and electrostatic. He showed that the use of a current-neutralizing conductor, as described by Mr. Taylor, would result in many practical difficulties in single-phase railway installations.

Mr. A. W. Copley described the scheme used by the New York, New Haven & Hartford Railroad to minimize the disturbance upon neighboring signaling circuits, while Mr. W. S. Murray said that the troubles are even less frequent upon the telephone and telegraph systems near the single-phase railway circuits than is the case with the average system not installed near a single-phase circuit.

Dr. C. P. Steinmetz remarked that neither the intelligence-transmission system nor the energy-transmission system has exclusive right to the ether. When disturbance upon one system is caused by the operation of the other, the two systems should co-operate to eliminate or minimize the disturbance. Dr. Steinmetz expressed his regret that no convenient method has yet been devised for representing the electrostatic fields so that one can obtain a physical conception of the relations expressed by the equation dealing with electrostatic phenomena somewhat analogous to the Faraday conception of lines of magnetic force. A possible method of dealing with electrostatic quantities is to determine, first, the inductance and then calculate the capacity from the relation existing between the velocity of propagation and the product of the inductance and the capacity.

In closing the discussion, Mr. Taylor stated that, although the scheme criticised by Mr. Scott has not been adopted in America, it has been used successfully in many European installations.

The New York Electrical Show.

The third annual New York Electrical Show at Madison Square Garden was opened to the public on Monday evening, Oct. 11, and will continue until Oct. 21. The decorations and electrical scheme, as well as the general architectural features, are unquestionably the neatest and most pleasing ever witnessed in the immense arena. Some conception of the scheme of decorations can be obtained from the general view herewith. Over 38,000 yd. of golden and white bunting were used in the overhead canopy and set of hangings encircling the arena and the effect is carried out so that no part of the building proper, except the floor and a few stairways leading to the balcony, is exposed. The canopy ceiling is divided into 56 panels, and at each intersecting division, grouped in an oval, is a candelabra with 72 25-watt tungsten lamps and a circle of 40-watt lamps. The latter lamps are of an amber hue, while the others are clear white. Over the center of the exhibits are six chandeliers 10 ft. in diameter, made up of metal and art glass of pleasing colors which harmonize with the general color scheme. These chandeliers are about 15 ft. from the ceiling proper, while the candelabras hang down about 22 ft. on a white column decorated with artificial flowers and leaves. Over the mezzanine floor there are 28 glass chandeliers, with about 15 ruby and amber-colored lamps in each, which help materially to heighten the general effect.

Down the center of the Garden there are two rows of white booths with a row of arches on the center of each block, dividing the booths and at the same time furnishing a sign to identify the various exhibitors. While this particular feature is essential to the exhibitors, Mr. M. A. Singer, who is responsible for the entire decorations, has arranged the sign scheme in such a manner that even this part, as well as the rest of the work, makes an attractive decorative feature of the show. The exhibits at the sides, which are up against the royal boxes, have an old-gold background with a white cornice relieved by a solid decorated pergola and artificial leaves and flowers. The entire Garden is surrounded with two rows of 25-watt tungsten lamps and the arches proper are lined with lamps of the same size and type. Between each arch there is a jardinière with a group of artificial lilies of the valley which are lighted up by 4-cp candelabra-base orange-colored lamps. Around the Garden and on the front of all booths are columns about 10 ft. apart surmounted by art glass tulip shades fitted with tungsten lamps. Taking the whole effect in consideration there seems to be nothing left undone to make the exhibition a pronounced artistic success.

GENERAL VIEW OF MADISON SQUARE GARDEN ARENA DURING ELECTRICAL SHOW.

Along the sides of the Garden and at the rear are the booths of the New York Edison Company, the United Electric Light, Heat & Power Company and the Edison Electric Illuminating Company of Brooklyn. Facing the entrance is the booth of the Public Service Corporation of New Jersey. In the first three booths there are very comprehensive exhibits of as many different electrical devices as can be crowded into the space, and the electric light companies have certainly very interesting displays. The Public Service Corporation uses its booth as a reception room and in addition to distributing literature shows a few photographs, including night views of Broad and Market Streets, Newark, which are illuminated in the business section by flaming arc lamps. Detailed descriptions of the exhibits of the lighting companies will be given in a later issue, and the other exhibits are described elsewhere in this issue.

The American Street and Interurban Railway Conventions.

The American Street and Interurban Railway Association and its allied associations held their 1909 conventions at Denver, Col., from Oct. 4 to 8. In addition to the controlling or parent organization there were present the following subsidiary associations: American Street and Interurban Railway Accountants' Association, American Street and Interurban Railway Engineering Association, American Street and Interurban way Engineering Asociation, American Street and Interurban Railway Claim Agents' Association, and American Street and Interurban Railway Transportation and Traffic Association. The usual large array of exhibits was made under the auspices of the American Street and Interurban Railway Manufacturers' Association. The exhibits and part of the convention sessions were held in the Denver Auditorium Building, which was enlarged temporarily by the addition of an annex of canvas tenting, which occupied a large part of two adjacent streets. Although far from Eastern centers, Denver is justly noted as an excellent convention city, because of its hotel accommodations, the natural attractions of Colorado and the hospitality of its people.

A number of special trains were run from various Eastern points. Most of these arrived in Denver on Sunday, the day before the opening.

The convention exhibits were opened Monday morning, and the registration began. Convention sessions began on Monday afternoon with meetings of the Claim Agents' and Transportation and Traffic Associations. The Claim Agents, after transacting some routine business, devoted the session to the discussion of the subject "What is the Best Means of Preventing Collisions of Cars with Vehicles and Pedestrians?" The Transportation and Traffic Association listened to the reports of its officers and discussed the report of its committee on passenger traffic, which brought out the advertising methods pursued by various companies.

On Tuesday morning both the Transportation and Claim Agents' associations held sessions. The claim agents in the morning discussed the advisability of having trainmen procure an increased number of witnesses to accidents; the practice of furnishing duplicate copies of the statements of injured parties to the injured parties, and the necessity for a school of instruction for trainmen in accident matters. In the afternoon the topical discussion was continued on the following subjects: Should information be furnished newspapers regarding the work of the claim department? What should be the relationship of the medical and claim departments? How can the medical best serve the claim department in the handling of accidents? The claim department and its relations to the operating department.

The Transportation and Traffic Association held one session on Tuesday, in the morning, and discussed the report of the committee on interurban rules. After a full session of discussion of the proposed rules, they were referred to the committee with instructions to confer with the committee on rules of the American Railway Association with the idea of making any changes that may seem desirable in either code, since it was not thought feasible to adopt the American Railway Association rules for electric railways.

The parent body, the American Street and Interurban Railway Association, held its opening meeting Tuesday afternoon. The session was presided over by President James F. Shaw, of Boston. The annual report of the executive committee was read by Secretary B. V. Swenson. President William G. Evans, of the Denver City Tramway Company, welcomed the convention to the city. Mr. B. V. Swenson read his report as secretary and treasurer. The annual address of the president was delivered. Reports were heard from four committees. These reports were on "Subjects," "Active Membership," "Associate Membership" and "Recommendations of Ex-President Goodrich."

A paper on organization from the standpoint of the smaller companies was read by Mr. Ernest Gonzenbach, president of the Sheboygan (Wis.) Light, Power & Railway Company. This paper was discussed at some length. The reading of the report of the committee on education concluded the work of the session, except as to some routine business.

The engineering association held its first session Tuesday afternoon. President Paul Winsor, of Boston, gave his address, which was followed by some routine business. The principal business of the session was the discussion of the report of the standing committee on "Way," which report had been in the hands of the members for a month.

On Wednesday morning the Engineering Association took up the report of its committee on equipment, which was noted in our issue for last week. Discussion of this occupied all of the morning and was continued over into the afternoon. Care of commutators and weights of cars were the subjects receiving the most time. The sizes of rolled-steel wheels recommended in the report were unanimously adopted and referred to the committee on standards. The committee recommendation for a change in the standard flange contour adopted in 1907 was rejected by unanimous vote. The gage recommended for pressing on steel wheels was not acceptable to the meeting and was referred back to the committee. A resolution was passed that the association take up the question of government and instruction of regular apprentices in the mechanical trades in connection with the maintenance of equipment of electric railways. On Wednesday afternoon the Engineering Association took up the subject of heat-treated axles, from which it appeared that the present requirements in specifications could be considerably increased. The report of the committee on generation was then taken up. The subjects most discussed were flue-gas analysis, steam meters and low-pressure steam turbines.

In discussing the report on equipment, Mr. John Lindall, of Boston, remarked that brush-holder defects cause excessive commutator wear, and that attention to the commutator alone with neglect of the brush holders is not wise. Mr. F. H. Lincoln, of Philadelphia, said that experience points to the advisability of adjusting the brush tension on motors by weight and adjusting the position of the brushes by measurement. Mr. William Roberts, of Akron, Ohio, said that brush tensions on his cars are tested with a small spring balance. This plan might be extended to rotary converters and generators. Considerable discussion followed on the practice which has become common for years of grooving out the mica between the commutator segments for a depth of about 1/32 in. when the mica proves to be too hard to wear down as fast as the copper of the commutator. The consensus of opinion seemed to be overwhelmingly in favor of such practise, and many are pursuing this method to the improvement of commutator life. Several are using slotting devices consisting of small circular saws for grooving out the mica between the segments.

Mr. Hugh Cowan, of Toronto, said that a pressure of from 7 lb. to 9 lb. is used on the motor brush-holders on his road. Much discussion was had of that portion of the committee's report which deals with car weights and the possibility of reducing them. All who discussed it endorsed the proposition that car weights could, and should, be reduced by more study of the matter. As one master mechanic pointed out, the Denver tramway system offers plenty of examples of substantial motor-cars weighing only 600 lb. per passenger, while, at the other extreme, some interurban cars weigh 1200 lb. per passenger. Standard wheels were discussed, and a standard tread for steel wheels was recommended to the committee on standards.

Following the discussion of the report of the committee on equipment, the report of the committee on generation was read by Mr. W. S. Twining. An abstract of this report, which dealt with flue-gas analysis, steam meters and low-pressure turbines, was given on page 849 of our issue for last week. In discussing the report, Mr. Charles Hewitt, of Philadelphia, presented the results of some interesting tests on flue gases. He said that the flue gases are sometimes erroneously assumed to be the result of combustion alone, whereas they are really the products

of combustion plus the air that has leaked in around the setting of the boiler. He presented four sets of continuous carbon-dioxide recorder records taken from the same boiler. The first chart showed 12 per cent carbon dioxide and was taken with the boiler setting and doors in the ordinary condition. The second chart showed 14 per cent, and was taken after the front and side doors were packed with a packing made of old pipe covering to reduce air leakage. The third chart showing 15 per cent was taken after the side doors had been bricked up to still further reduce air leaks, which were very apparent. The fourth chart showed from 17 per cent to 18 per cent, and was the result of further stopping of leaks through the setting by coating the brick work of the setting with three coats of liquid Portland cement and one coat of cold-water paint having a gypsum base. A chart taken from another boiler, which stood alone, and had not only front and side doors in the setting, but also back doors, showed 4 per cent carbon dioxide, which was increased to from 10 per cent to 12 per cent by packing the doors.

Mr. C. K. Durbin, of Denver, gave an interesting account of the experience of one of the small companies in his syndicate which had purchased a carbon-dioxide recorder, and, after considerable study and effort, had thought it hopeless to try to get results with it. After a little further study, however, resulting in the stopping of leaks of air, marvellous results were obtained. Now the company would not be without the instrument. The plant burns oil.

The chairman called for discussion of that part of the report devoted to steam meters. From the limited discussion that followed it is apparent that most steam meters are in somewhat of an experimental state. Mr. Hewitt, of Philadelphia, told of installing a St. John's steam meter on the auxiliaries in one power plant and finding it accurate within 3 per cent as checked by weighing the condensation. He found that the steam-blower engines were taking 10 per cent of the steam generated. It is intended to replace them with turbine blowers, which, it is hoped, will operate on 3 per cent of the steam generated.

In the discussion on exhaust-steam turbines it was brought out that the cost per kilowatt of the exhaust turbines and all other necessary appliances in the Philadelphia plant was about $80, which was lower than the cost of additional plant equipment secured in any other way. If condensing water had been available so as to render a cooling tower unnecessary, the cost would have been about $50 per kilowatt. These figures were given by Mr. W. S. Twining, of Philadelphia.

The Accountants' Association held its first session on Wednesday morning. President R. N. Wallis read his address. Mr. H. E. Weeks presented his report as secretary and treasurer, and also the report of the executive committee. A paper by Mr. S. C. Rogers, of Youngstown, Ohio, on "Interurban Statistics" was read by Mr. W. H. Forse, Jr. A long discussion on this took place. The remaining work of the session was the report of the standing committee on a standard system of accounts.

The Transportation and Traffic Association on Wednesday morning discussed the report of its committee on express and freight traffic. The operating expense of such traffic was talked over at length. The rest of this session was given to the discussion of the rules offered by the city rules committee, which was concluded Thursday.

The Claim Agents held their last sesison on Wednesday morning. Three papers were read on "The Unreported Claim; Its Evils and Remedy." Discussion of these, together with the election of officers and appointment of committees, completed the business of this association.

The parent organization met in executive session on Wednesday afternoon and discussed the report of the committee on Interstate Commerce Commission affairs and that of the committee on compensation for carrying United States mail.

On Thursday the Transportation and Traffic Association continued its discussion of city rules. The rules reported were adopted, subject to their further amendment. A paper on "The Chicago Transfer Crusade," written by Mr. J. V. Sullivan, of Chicago, was read by Mr. Beach. After discussion of this paper, the subject of "Training of Transportation Employees" was taken up, and a paper on the subject was read by Mr. Charles B. Wells, of Denver. This brought out a long discussion, which was continued until the election of officers, which closed the convention of this association.

At the Thursday session of the Accountants' Association, Mr. N. E. Stubbs, of Baltimore, read his paper on "Payrolls and Timekeeping." This was discussed at length. A paper on "The Electric Railway Auditor, His Duties and Relations to the Organization," by Mr. W. B. Brockway, was read in the absence of the author and drew out some discussion. "Stores Accounting and Inventory" was the subject of a paper by Mr. E. S. Pattee, of Minneapolis. After receiving the report of the committee to consider shop accounting jointly with a committee of the Engineering Association, and election of officers, this convention adjourned.

On Thursday morning the Engineering Association took up the report of its committee on standards and the report on energy distribution, the discussion of which occupied the entire morning session. On Thursday afternoon the joint committee on shop accounting reported. The report of the committee on energy distribution, of which Mr. James Heywood was chairman, dealt with the specifications for material used in energy distribution, including feeders, contact conductors, return systems and conduit systems.

For high-tension transmission lines the report gives favorable comments on steel towers and suspended insulators. It was stated that steel towers decrease the fire risk, are more portable than wood poles, and are cheaper when the extra durability is considered. In comparison with the pin-and-petticoat insulator, the suspended insulator possesses superior mechanical strength, a higher factor of safety in dielectric strength, greater accessibility for cleaning and observing and affords greater durability to the conductor.

For low-tension underground service the committee recommended the use of paper-insulated, lead-covered cable. Triple weather-proof braid is said to provide sufficient insulation on overhead low-tension cables to prevent crosses with telephone and other low-tension wires.

A short discussion was had on the two recommendations of the committee, one as to the adoption of a standard section of grooved trolley wire, and the other as to adopting a new wire table. The grooved trolley of 211,600 circ. mils cross-section, as recommended, was adopted. In regard to the wire table it was explained that the confusion arising from the various gages in use induced the committee to recommend that wire and sheet metal gage numbers be abolished in ordering material, as requested by some of the manufacturers, and that the diameter always be expressed in decimal parts of an inch. This recommendation was put to a vote and adopted and recommended to the committee on standards. By this recommendation also the size of stranded conductors should be stated in circular mils rather than by gage number.

On the subject of pole preservation Mr. Martin Schreiber, of the Public Service Railway of New Jersey, estimated the cost of treating poles by the brush method as from 20 to 30 cents for material and 5 cents for labor, and for the tank method as from $1.50 to $2 per pole. His company experimented recently to prevent the absorption of too much of the liquid in tank treatment around the butt of the pole where only a little is needed. A coating of cement had not been successful for this.

Mr. W. G. Matthews, of the Denver City Tramway, reported that after noting an experiment of the Colorado Telephone Company with the brush treatment with carbolineum his company began, in 1904, the treatment of poles in this way, and now has about 1300 poles so treated. Another plan being tried is to put 6 in. of concrete around the pole the entire depth of the hole and bring it up to a cone at the top. Another is to put concrete only 3 ft. below the ground and a few inches above.

Officers for the engineering association were elected as follows:

President, Mr. F. H. Lincoln, assistant general manager, Philadelphia Rapid Transit Company, Philadelphia, Pa.; first

vice-president, Mr. W. J. Harvie, chief engineer, Syracuse Rapid Transit Company and Utica & Mohawk Valley Railway Company, Syracuse, N. Y.; second vice-president, Mr. E. O. Ackerman, engineer maintenance of way, Columbus Railway & Light Company, Columbus, Ohio; third vice-president, Mr. J S. Doyle, superintendent of car equipment, Interborough Rapid Transit Company, New York; secretary-treasurer, Mr. John W. Corning, electrical engineer, Boston Elevated Railway Company. Executive committee: Mr. Martin Schreiber, engineer maintenance of way, Public Service Railway Company, Newark, N. J.; Mr. W. H. McAloney, superintendent of rolling stock, Denver City Tramway Company, Denver; Mr. John Lindall, superintendent of rolling stock and shops, Boston Elevated Railway Company, Boston, Mass.; Mr. Thomas Elliott, chief engineer, Cincinnati Traction Company, Cincinnati, Ohio.

The parent association on Thursday afternoon accepted the rules for city operation adopted and recommended to the parent association by the Transportation and Traffic Association. Officers of the American Street and Interurban Railway Association were elected by continuing those of last year in office, as follows:

President, Mr. James F. Shaw, chairman board of directors, Boston & Worcester Electric Companies, Boston, Mass.; first vice-president, Mr. Arthur W. Brady, president, Indiana Union Traction Company, Anderson, Ind.; second vice-president, Mr. Thomas N. McCarter, president, Public Service Railway Company, Newark, N. J.; third vice-president, Mr. George H. Harries, second vice-president, Washington Railway Electric Company, Washington, D. C.; and fourth vice-president, Mr. Charles N. Black, vice-president and general manager, United Railroads of San Francisco, San Francisco, Cal.

The entertainment features provided were too numerous to be mentioned at length here. Probably the event that will live longest in the memories of most of the delegates was the barbecue held at the White City. This was altogether of wild game from the Rocky Mountains served by "cow punchers," and was given by the Denver City Tramway Company. On one evening the Manufacturers' fifth annual vaudeville and theatrical performance was given. Most of the talent for this event was furnished by the conductors and motormen of the Denver Tramway. Some really excellent performances were given. The ladies were taken on sight-seeing trips over the city and interurban lines of Denver and on Friday, after all the sessions had been held, all took a trip up the Moffat Railroad to the continental divide where the snow stood deep and the thermometer registered 15 above zero. On Thursday evening the entire house at the Broadway theater was engaged for the convention to see Mrs. Leslie Carter in "Vastaherne."

Convention of Colorado Electric Light, Power and Railway Association.

The Colorado Electric Light, Power and Railway Association held its annual convention this year at Denver, beginning Oct. 7, the last business day of the American Street and Interurban Railway Association convention. The first session was held at the Hotel Auditorium on Thursday morning, at which time President J. F. Dostal, of Denver, delivered his address and a number of questions from the Question Box were taken up. Mr. Frank W. Frueauff, past-president of the association and president of the National Electric Light Association, gave a very interesting talk on the work which the present administration of the national association is carrying out. In the afternoon Mr. James R. Cravath, of the *Electrical World*, gave a talk illustrated with blackboard drawings on "Recent Progress in Illuminating Engineering."

The program included papers as follows: "Notes on Meters and Meters Operating with Series Transformers," by Mr. F. P. Cummings, of Denver; "Selling Electricity," by Mr. H. H. McConnell, of Colorado Springs; "Notes on Grounded Secondaries," by Mr. W. J. Canada, of Denver. An abstract of the paper on grounded secondaries is given elsewhere in this issue. Abstracts of other papers and discussions will appear in later issues.

Convention of Car-Lighting Engineers.

The Association of Car Lighting Engineers held its second annual convention in Chicago from Oct. 4 to 7. The report of the secretary, Mr. G. B. Colegrove, reported a total membership of 390, an increase of more than 100 per cent during the past year.

In his presidential address, Mr. A. J. Farrelly outlined the history of the association since its inception in May, 1908, the credit for its formation being given to Mr. E. M. Cutting, of the Southern Pacific. In explaining the present status of the organization, the president remarked that the objects of the association, the betterment of its members and the improvement in the service of the railroads, will surely result in the choice of the members to fill better positions and places of greater responsibility.

The fact that the name originally adopted for the association was not sufficiently comprehensive for the real objects of the organization having been brought to the attention of the members, it was voted to adopt the name "Association of Railway Electrical Engineers," proposed by Mr. A. J. Collett.

Mr. J. H. Klink addressed the convention on the subject of the application of electricity to railway shops. He remarked that there are now used two general kinds of electric systems, the alternating current and the direct current, while a combination of the two systems is coming into prominence. Experience shows the combination system, employing alternating current for generation and transmission and a certain amount of direct current for distribution, to be the preferable one for railway shops when the energy must be transmitted over a considerable distance. For shop tools direct-current motors, with some method of speed control, have been found necessary.

Many arguments might be advanced to show the superiority of electric drive for railway shops, and wherever it has been tried it has been found satisfactory. Although the first cost is a great consideration, the unit cost of production is decreased because the output is increased. The ability to locate the machinery wherever desired, and without regard to line shafting or the power plant, makes the electric motor ideal.

The choice between alternating-current and direct-current motors is still an open question. For wood-working and blacksmith shops and other places where the speed required is practically constant, the tools should be grouped with a short line shaft operated by an alternating-current motor. For individual tools a direct-current motor should be used. Motors are usually mistreated by the workmen until they burn out, so that alternating-current motors give less trouble than do direct-current motors. The majority of recent installations are with variable-speed motors, the ratios being 3 to 1 and 4 to 1, at 125 volts or 250 volts. Multiple-voltage systems are practically a thing of the past. Alternating-current motors will probably be used more generally in the future as better types are developed.

The discussion was participated in by Messrs. Pomeroy, Hutchinson, Farrelly, Gilman, Collett and Cartwright. Mr. Gilman remarked that both direct-current and alternating-current motors used in the shops of the Chicago, Milwaukee & St. Paul Railroad have given very little trouble. Alternating-current motors are very satisfactory. One man can take care of 150 alternating-current motors, while the same man can look after only 50 direct-current motors. However, the repairs to the direct-current motors are so slight that one spare armature is sufficient for 45 motors.

The report of a special committee on axle generators, which was read by Mr. J. R. Sloan, dealt with the design and construction of the axle generator proper and its auxiliary apparatus; the operation of the battery in connection with the axle generator, and the operation of the lamps. In regard to permissible voltage variation, good practice allows a variation

of 1½ per cent above or below normal, while fair practice will admit of a 3⅓ per cent variation; a variation greater than this value may be considered poor. The major portion of the report was devoted to details of design of axle generators and auxiliary devices. The committee recommended that the insulation be made heat, oil and moisture proof, and that the lamp voltage be controlled within 1.5 per cent of normal. The "floating" method of charging batteries was recommended.

The report was discussed by Messrs. G. B. Colgrove, N. E. Lemon, A. J. Farrelly, Alex. McGary, J. R. Sloan, O. W. Ott, G. W. Murray, D. J. Cartwright and W. L. Bliss. In reply to a question by Mr. Colegrove as to the use of a low-voltage release on the batteries, Mr. Bliss stated that it would be very dangerous to install such a device, because the circuit might be opened just at a time when it was most important to have light. However, some sort of a warning device, which would announce the approaching depletion of the battery, could well be utilized.

Mr. D. J. Cartwright read the report of the committee on standards. Among the recommendations offered were that the standard e.m.f. for head-end or straight-storage car lighting be made 64 volts; that the standard e.m.f. for axle car lighting be made 32 volts, and that all electrically lighted cars be provided with an overhead train line connection of three wires.

The report of the committee on lamps was read by Mr. H. C. Meloy. The committee recommended that the use of tipless lamps be avoided in all locations except berths, and that only round-bulb lamps be employed. This paper was discussed by Messrs. B. F. Fisher, W. L. Bliss, R. E. Schaulen, A. J. Farrelly, F. R. Frost and D. J. Cartwright. As a result of the discussion, it was recommended that train-lighting lamps exposed to view be so treated as to minimize the bad effects upon the eyes.

Storage batteries for train lighting were discussed in a paper by Mr. H. M. Beck. The author remarked that a battery should be given regular attention so as to prevent trouble before it occurs. In charging the battery it is important not to carry the regular charges too far and to keep below the temperature limit. The cells should not be over-discharged or allowed to remain completely discharged. The plates should always be covered with electrolyte, the strength of which should be within the proper limits.

In reply to questions by Messrs. Seymour, Hutchinson, Cravens, and Lunn, Mr. Beck stated that it is best for the specific gravity not to exceed 1.225. Temperatures higher than 100 deg. may injure the battery.

A committee, of which Mr. J. A. Shaw was chairman, submitted a report dealing with improvements in electric train-lighting systems, which was read by Secretary Colgrove. During the past year there has been a noticeable increase in the proportion of axle-generator equipments installed. This system is advantageous in that each car is individually independent of all other cars. For suburban trains the engines of which are not changed the head-end system employing steam turbo-generators has proved satisfactory; there are now 194 sets of this type in service in this country. Lighting directly from storage batteries has received a strong impetus with the development of the tungsten lamp.

In a paper entitled "Electrification of Steam Railroads," Mr. George W. Cravens stated that among railroad men it is quite generally recognized that the change from steam to electricity will eventually come. Under the conditions existing in Illinois, Indiana and Ohio, where there are about 5000 miles of electric lines as against about 30,000 miles of steam roads, the cost of operation by electricity averages 15.8 cents per car-mile. This cost is divided as follows: 3.7 cents for energy; 5.4 for operation; 1.3 for maintenance of cars and equipment; 1.7 for maintenance of a permanent way, and 3.7 for operation. The cost of operating steam railroads averages between 40 cents and 60 cents per car-mile. It will be seen, therefore, that the possible earnings under electrification are much greater than they are under steam.

In discussing Mr. Craven's paper, Mr. Pomeroy remarked that there exists on the part of steam-road managers a noteworthy thirst for real and definite information concerning electrification. In estimating the cost of operation by steam and electricity it is difficult to compare one road with another on account of the wide variation in conditions. The comparative cost per car-mile is not the only criterion, because in some cases it is possible to handle with electricity on two tracks traffic that requires four tracks with steam.

In reply to a question by Mr. Seymour, Mr. Craven stated that electrification has been adopted up to date principally for two reasons, namely, cleanliness and saving in operating expenses; incidentally there has been an increase in earnings from local short hauls due to the flexibility of the service.

A paper by Dr. Max Buttner entitled "Electric Train Lighting on European Railroads" was read by Mr. J. H. Klink. Nearly all of the Swiss, Danish and Italian State lines are equipped with electric train-lighting systems, and the Roumanian, Turkish, Hungarian, English, French, Belgian and Russian roads have a good many electrically lighted cars, although a large number of the Russian cars are still lighted with candles. Most of the cars on the German and Austrian lines still use gas lamps. Some of the privately owned lines in Sweden are electrically lighted, but few of the others are. The same thing applies to lines in Norway, Spain, Servia and Portugal. Turbo-generators are used in Europe; the steam is not taken from the locomotive, but is obtained from a boiler installed in the car. Axle generators are used in Prussia, France and England to some extent. Head-end systems, with batteries, are used in Germany, Denmark and Sweden, as are also straight batteries with charging stations at terminals of the lines; where batteries are used the practice of changing the batteries has not been adopted, but the cars are held long enough to recharge. Gasoline-engine-driven generators are used to some extent in Russia. It is the growing belief in Europe that an e.m.f. of 32 volts will be found suitable for all services.

The following officers were elected for the ensuing year: President, Mr. E. M. Cutting, engineer of train lighting, heating and ventilation, Southern Pacific Railway, Oakland, Cal.; first vice-president, Mr. J. R. Sloan, electrical engineer, Pennsylvania Railroad, Altoona, Pa.; second vice-president, Mr. F. R. Frost, electrical engineer, Atchison, Topeka & Santa Fé Railroad, Topeka, Kan.; secretary and treasurer, Mr. Geo. B. Colegrove, chief electrician, mechanical department, Illinois Central Railroad, Chicago.

The next annual convention will be held in Chicago on Oct. 4, 5, 6 and 7, 1910, and a semi-annual meeting will be held in Buffalo on June 7 and 8, 1910. As one of the phases of the activity of the association there was formed the "Car Lighting Club," which will meet informally for luncheon and discussion at times and places yet to be determined.

The chief entertainment feature of the convention was an informal banquet and dance held on the evening of Oct. 6, at which there were present 250, of whom 50 were ladies. The toastmaster was Mr. C. E. Brown, who introduced as the speakers President Farrelly and Messrs. M. E. Towner, G. B. Colegrove and E. M. Cutting.

Canadian Hydroelectric Commission.

A meeting of representatives of the different cities and towns who have agreed to take power from the Hydroelectric Power Commission was held in Toronto last week, with Hon. Adam Beck, chairman of the commission, presiding. Mr. P. W. Sothman, chief engineer of the commission, reported that Preston, Hespeler, Galt and Berlin will receive power next March, by which time power will be also delivered to Toronto. There are four gangs at work on the main transmission line, which it is expected to be ready before the municipalities have their distribution stations completed.

An action of Walter D. Beardmore to restrain the city of Toronto from entering into a contract with the commission will come before the courts for decision very soon, the statement of claim having been filed last week. The plaintiff alleges that the

city corporation had no authority to enter into contract with the Hydroelectric Commission to take 10,000 hp, claiming that the contract does not conform to by-law No. 4834. The plaintiff also wants the Crown added as a third party, further claiming that the Government has no power to carry on such business and that the Acts of the Legislature bearing on the subject are unconstitutional.

An action brought by R. S. Morris to restrain the city of Hamilton from entering into a contract with the Hydroelectric Commission for electric power has been dismissed by Chief Justice Meredith. By this decision the corporation is now in a position to deal with the commission and at a recent special meeting of the power committee the city solicitor was instructed to prepare formal application to the commission at once for 1000 hp.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has ordered an investigation of the proposed operation of cars by the New York & Queens County Railroad over the new Queensboro Bridge. Although the commission has not issued any permit for this operation, the Board of Estimate has authorized the bridge commissioner to issue a temporary permit. It is to establish its legal authority that the commission has taken action.

The Board of Estimate and Apportionment of New York City last week set aside $1,500,000 for the purpose of lengthening the platforms of the subway stations in order to accommodate six-car local and 10-car express trains. The Public Service Commission has already approved of this improvement and has prepared plans for the work. A requisition was made on the Board of Estimate for the money on June 2, 1909.

The Public Service Commission, Second District, will give hearings at Albany this week on the application of the Plattsburgh Gas & Electric Company for authority to issue a mortgage for $500,000 and to issue presently $340,000 in 5 per cent 30-year bonds, and the application of the Oswego River Power Transmission Company for authority to issue a first mortgage for $100,000 and to issue at present $65,000 of 5 per cent 20-year bonds.

On Friday, at Buffalo, the commission will hear the application of the Genesee Light & Power Company asking for permission to issue capital stock. The company is organized to take over the property and franchises of the Genesee County Electric Light, Power & Gas Company. Request is made for authorization to issue 1000 shares of preferred stock and 1500 shares of common stock at the par value of $100 per share, and also the complaint of the Cazenovia Business Men's Association, Dr. H. H. Glosser and others against the International Railway Company as to service on the Abbott-South Park Line in the city of Buffalo.

The commission has consented to the merging by the Nassau Light & Power Company of the Nassau Gas, Heat & Power Company, Floral Park Light & Power Company and the Oyster Bay Electric Light & Power Company.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has placed on file a supplementary agreement between the Fitchburg Gas & Electric Light Company, under date of Oct. 1, in connection with the distribution contract of Aug. 30, 1909, abstracted in these columns last week. The supplementary agreement provides that when the distribution agreement has been in force 10 years from its date, and again when it has been in force 20 years, the Board of Gas and Electric Light Commissioners may, by its order, but only upon the petition of the Mayor and Aldermen of the city of Fitchburg, filed not later than Jan. 1, 1919, and Jan. 1, 1929, respectively, and after a hearing duly noticed, make such reasonable modifications of the terms of the agreement as the public interests require. Such orders are to be effective only if made before Aug. 30, 1919, and Aug. 30, 1929. If the modifications of the agreement are unsatisfactory to either of the parties, such party may elect to rescind the agreement by notifying the other party in writing within 30 days after the making of the board's order, and in that event the agreement becomes null and void, and the modifications not effective.

The Gas and Electric Light Commission approved the issue of new capital stock to the amount of $5,000 for the purchase of the plant and business of E. Leroy Gardner, of Chester, by the Chester Electric Light Company.

Hearings were resumed during the past week by the Massachusetts Railroad Commission and the Boston Transit Commission, sitting as a joint board, on various proposed additions and consolidation matters relating to the transportation system of the Boston Metropolitan district. On Oct. 5 an extended hearing was given on the proposed extension of the elevated structure of the Boston Elevated Railway Company from the present Sullivan Square terminal to Medford. The proposed route passes through the city of Somerville, and at the hearing much opposition to an elevated structure developed among officials and residents of that municipality. The construction of a subway or a surface line on Mystic Avenue was favored. Officials and citizens of Medford favored the construction of an elevated line, considering the cost of a subway prohibitive and a new surface line as an inadequate solution of the problem. Further protest against an elevated line will be heard on Oct. 13. The proposed Boston, Lowell and Lawrence electric interurban high-speed line is adversely considered by the opposition to an elevated structure in Somerville. The situation is somewhat complicated by the uncertainty existing in regard to a possible electrification of the suburban lines of the Boston & Maine Railroad by the controlling interests in the new Boston Railroad Holding Company—an organization chartered by the Legislature of 1909 practically to permit the control of the Boston & Maine system by the New York, New Haven & Hartford Railroad Company for the purpose of unifying steam transportation in New England. It is probable that a suitable electrification of the suburban lines would greatly modify the demand for new elevated lines in the Boston district.

The joint commission gave a hearing on Oct. 8 on the proposed consolidation of the West End Street Railway Company and the Boston Elevated Railway Company. Mr. Frederick E. Snow, counsel for the Boston Elevated Railway interests, urged the necessity for the consolidation and the willingness of the company to meet reasonable terms. The West End company was represented by Messrs. H. Heustis Newton, F. S. Mead and Charles Williams, who emphasized the strong financial position of the West End before its lease, about 12 years ago, to the Elevated. The West End company owns the surface lines in the Boston system, and its stockholders desire to be placed in an impregnable position in case the consolidation goes through. Counsel Mead stated that by the terms of the proposed consolidation, referred to the joint board by the Legislature of 1909, the stockholders of the West End are asked to give up their position as secured creditors and become partners in an organization which is relatively less prosperous than when the West End was in control. A chart was shown to the board to indicate that there has been no relatively large increase in business since the establishment of the lease. It is felt that the Boston Elevated property is somewhat handicapped by the increasing cost of operation and taxes, the unprecedented extension of transfer facilities and lengthening haul per passenger, and the heavy fixed charges which must be paid on the elevated, tunnel and subway construction, to which the company has been, and still is, committed.

The Railroad Commission has issued an order sustaining the Boston & Northern Street Railway Company in the petition of the Selectmen of Peabody for a reduction of the fare between Peabody Square and Salem Willows from 10 cents to 5 cents. The board states that the traffic on the line between Town House Square, Salem, to Salem Willows is considerable during the summer, but extremely light during the rest of

the year. After investigating the returns of the company, other fares on the system and the travel, with special care, the board concludes that the fare is neither unreasonable nor excessive and that the reduction asked would require the portion of the line between Town House Square and the Willows to render a free service to Peabody passengers. The petition is, therefore, dismissed.

The Railroad Commission has approved the consolidation of the Middlesex & Boston and the Newton & Boston Street Railway Companies, including the issue of $200,000 worth of stock by the former to effect the purchase.

An order has been issued by the Railroad Commission recommending the establishment of a free transfer point at the Boylston Street station of the Tremont Street subway, in Boston, for the use of passengers entering the subway at Park Street who desire to reach the South Terminal Station. The removal of elevated train service from this subway seriously interfered with transportation facilities between Park Street and the South Station. The present arrangement, as recommended, is not without its objections, in the opinion of the board, but it is to be tried experimentally until March 1, 1910. The board states that it is to be hoped that ultimately improved facilties may be established between these points. It is probable that legislative authority for the extension of the Cambridge subway from Park Street to the South Station will be granted in the near future.

Wisconsin Rate Commission News.

The application of the Cumberland municipal electric lighting plant for authority to increase its rates was granted by the Wisconsin Commission on Oct. 4. The testimony introduced at the hearing, as well as the investigations made by the commission, showed that the revenues received for electric lighting fall short of covering the operating expenses. In attempting to apportion the operating expenses in order to arrive at a satisfactory basis for rate making, considerable difficulty was experienced due to a lack of proper station data. From a study of conditions existing in other plants throughout the State it was found that 45 per cent of the operating expenses can be considered as fixed and 55 per cent as variable or output expenses.

The variable expenses to be met by the consumers must be apportioned over the kw-hour consumption for the year. No data was introduced covering the consumption of the various classes of consumers, nor was the output of the station by months given. No record was to be had of the connected load by classes or consumers. Consequently it was necessary to estimate the probable output.

From the annual reports submitted by a large number of electric plants in cities of from 1000 to 30,000 population, the average installation of various classes of consumers has been determined as shown in Table I. The connected load multiplied by the hours daily use of the same was used to obtain the daily and annual consumption in kw-hours for the different classes of consumers.

TABLE I.—AVERAGE INSTALLATION IN KILOWATTS.

Schools	3.06	Livery Stables	.57
Residences	.76	Factories	1.95
Saloons	.69	Hotels	2.70
Offices	.63	Restaurants	.76
Stores	1.02	Theaters	5.58
Laundries	.59	Churches	2.48
Depots	1.36	Lodge Halls	1.54

The plant, at the request of the commission, submitted a list of the metered consumers for the month of December, 1908. The number of unmetered consumers was known and their consumption was estimated as being the same proportionately as that of the metered consumers. There has been prepared in connection with this case a statement of the current output by months for a number of cities, with the per cent of yearly output worked out for each month. All cities with unusual load fluctuations have been eliminated.

From the above table the probable yearly and monthly outputs were determined and these with the estimated outputs determined by the other methods gave what was considered to be a satisfactory basis for rate making.

The commission recommended that 10 cents per kw-hour be charged for the first 30 hours' use per month of the active load, and 8 cents for all over 30 hours, with a minimum charge of 75 cents per month. The active load for residences and churches is to be considered as 50 per cent of the full connected load, and for all other classes of service, 100 per cent.

In the decision the question of fixed and variable expenses has been dealt with, as well as the subject of depreciation and the necessity for a depreciation reserve. These explanations have been made chiefly for the benefit of the municipal plants, where there seems to be a woeful lack of knowledge concerning such questions.

TABLE II.—MONTHLY OUTPUT IN PER CENT OF YEARLY OUTPUT.

July	5.91	Nov.	10.32	Mar.	8.20
August	6.18	Dec.	12.05	April	7.02
Sept.	7.67	Jan.	11.35	May	6.59
Oct.	9.26	Feb.	9.35	June	6.11

In 1908 the commission ordered the Douglass County Telephone Company to discontinue its free service, which, as a competing company, it had offered certain city officials of the city of Superior on condition that it be given connections with the city building, on the ground that such service was discriminatory. Although the company was willing, the city enjoined the company from taking out its telephones and sought to set aside the ruling of the commission. In a recent decision the Supreme Court has held that the contract is valid, and that the commission has no authority to set it aside. The court upholds an independent contract for free service if the contract was entered into before the passage of the public utilities law.

The hearing in the case of the Milwaukee petitioners against the Milwaukee Electric Light & Railway Company alleging inadequate service has been postponed until Oct. 20.

CURRENT NEWS AND NOTES.

ILLUMINATING ENGINEERING AND OPHTHALMOLOGY.—By invitation, Mr. L. B. Marks last week addressed the annual meeting in New York of the American Academy of Ophthalmology, the members of which include the leading oculists of the United States. In his address Mr. Marks made a plea for co-operation between the illuminating engineer and the oculist, and the Academy will probably take some action in the matter.

ATMOSPHERIC NITROGEN.—What is stated to be one of the largest orders ever placed for electrical apparatus in Europe is for generators for producing saltpeter from atmospheric nitrogen at Christiana, Norway. There will be five 17,000-kva, 11,000-volt, three-phase alternators designed for coupling to water turbines. These generators will be built by Brown, Boveri & Company, of Baden, Switzerland. The station of A. S. Rjukanfos, in which these alternators will be placed, is being designed for an ultimate equipment of 10 17,000-kva units.

GROUNDED SECONDARY IN COLORADO.—At the recent annual convention of the Colorado Electric Light, Power & Railway Association a committee was appointed to investigate the grounding of secondaries, and make a thorough trial by actual operation in as many cities as possible in the Rocky Mountain territory. Among the objections to grounding in this territory has been the prevalence of thunderstorms and difficulty in making good earths. The latter point will be made the subject of study. At the meeting of the association practically no opposition to grounding developed in the discussion of that subject.

UNITED WIRELESS STATIONS.—The United Wireless Telegraph Company has issued a list of stations, showing that it has now in commercial operation 97 land stations and 204 ship stations.

WIRELESS OVER 3500 MILES.—The army transport Bulford, which arrived at Manila on Oct. 6, reported that wireless messages were exchanged with the Pacific coast over a distance of 3500 miles.

AURORA BOREALIS AND CABLE SERVICE.—As previously noted, magnetic effects accompanying a display of aurora borealis seriously affected cable service on Sept. 25, and the same cause operated to block cable service for about an hour on the afternoon of Oct. 8.

ILLINOIS STATE ELECTRICAL ASSOCIATION CONVENTION.—The Illinois State Electrical Association will hold its annual convention this year at Alton, Ill., according to a notice recently sent out by Secretary H. E. Chubbuck, of Peoria. The dates are Oct. 26, 27 and 28. Exhibits by supply houses are invited.

PEA VINE DISABLES A TRANSMISSION SYSTEM.—A 24-hour shut-down of numerous manufacturing plants in Statesville, N. C., and also the suppression of all electric lights was produced recently by the contact of a matured pea vine with the transmission circuit of the Southern Power Company. During a storm the vine was carried on the wires from a stack of pea hay that had been piled close under the transmission line between two towers.

PITTSBURGH ELECTRIC TRACTION INQUIRY.—The Pittsburgh Civic Commission, which is said to be backed by Andrew Carnegie and H. C. Frick, has secured the services of Messrs. B. J. Arnold, J. R. Freeman, of Providence, and Frederick Laws Olmstead, of Boston, for the purpose of getting advice as to the improvement of the Pittsburgh street-car service, the river front and the park system. It is said that the experts will receive $800 a day for their services.

BALTIMORE ELECTRICAL SHOW.—A movement to hold a large electrical show in Baltimore within the next few months is gathering shape. An effort will be made to induce Mr. W. D'A. Ryan, illuminating engineer for the General Electric Company, to come to the city with his scintillator, which was one of the striking features of the Hudson-Fulton celebration. To insure the success of the exhibit it will be necessary to make arrangements for a large sum of money, as the exhibits are being planned on a very elaborate scale.

NEWS BY TELEPHONE.—A company has been incorporated having for its object the publication of news by telephone. Mr. Manley M. Gillam, president of the company, said that within a year subscribers in New York City will be furnished with telephone news of general interest, political happenings, baseball reports by innings, etc. He said that the plan of distributing news by telephone has met with success in London, Paris, Vienna and Budapest, and that the same general lines followed in these places will be pursued here when the telephone news service is established.

CHICAGO ELECTRICAL SHOW.—The Electrical Trades Exposition Company announces the dates for the 1910 Electrical Show, which will be held in the Coliseum, Chicago, Jan. 15 to 29, inclusive, 1910. This show will be under the same management as the four previous annual successes, and plans are under way for booths, decorations and lighting effects which will surpass the beautiful effects of previous shows. The benefits to manufacturers, contractors and dealers derived from this annual trade booster have been thoroughly demonstrated, and indications are that the 1910 show will be participated in by all of the leading firms in the electrical field. Offices have been opened at 115 Dearborn Street, Chicago, where all inquiries will be received and full information and details given regarding the show.

DENVER A. I. E. E. SECTION.—Secretary Ralph W. Pope, of the American Institute of Electrical Engineers, who has recently been making a tour of the far West to further the work of that body, stopped in Denver the week of the railway convention and was given a luncheon at the Brown Palace Hotel, Oct. 7. Prof. W. E. Goldsborough, now of Denver, presided. Several other out-of-town members of the Institute were also present. The speakers were Professor Goldsborough, Mr. Pope, Messrs. Chas. Hewitt, of Philadelphia; J. F. Dostal, of Denver; O. B. Coldwell, of Portland, Ore., and James H. McGraw, of New York. As the result of Mr. Pope's visit an A. I. E. E. Section will be organized by members in Denver and contiguous territory. A section is being organized in Salt Lake City, and several centers on the Pacific Slope have under consideration the establishment of sections.

WORCESTER POLYTECHNIC GRADUATES IN COLLEGE WORK.—Among recent appointments of graduates of the Worcester Polytechnic Institute to the electrical engineering staff of colleges are the following: A. B. Holcomb, 1908, instructor in electric engineering of Sibley College, Cornell; A. R. Powers, 1907, instructor in electrical engineering at the University of Pennsylvania; E. B. Paine, 1897, assistant professor of electrical engineering at the University of Illinois, has been appointed acting head of the electrical engineering department during the absence of Prof. Morgan Brooks on leave; R. H. Taber and C. E. Putnam, both 1909, graduate assistants in electrical engineering at the Worcester Polytechnic Institute; A. T. Childs, 1906, instructor in electrical engineering at the University of Maine; R. P. Clarkson, 1908, instructor in electrical engineering at the University of Vermont.

A CENTRAL-STATION SOLICITOR ABSCONDS.—The Topeka Edison Company reports that Norman Miner, who has been in its employ since February, 1908, as a solicitor, absconded from Topeka on Sept. 25, 1909, after cashing a number of worthless checks with Topeka merchants. Miner also abandoned his young wife, a Topeka girl whom he married in January, 1909, leaving her destitute. The man was employed for a short time as solicitor at Dubuque, Ia., and was also on the road for the Curtis Advertising Company, of Detroit. Previous to his employment by the latter he was for a time a solicitor with the Denver Gas & Electric Company. The Topeka merchants who were victimized will be glad to learn of this man's whereabouts. He also left a number of unpaid accounts and two merchants are endorsers on notes for a total of $650 which they will have to pay. Miner's parents are respectable people now residing in Brooklyn, N. Y. His name is Meinhold, the name Miner being one assumed by the young man for reasons best known to himself.

COLORADO SPRINGS ELECTRICAL ORDINANCE.—The city of Colorado Springs, Col., has under consideration the adoption of a comprehensive electrical ordinance along the lines of Denver's recent ordinance. The drafting of the ordinance is in the hands of the city attorney, who is consulting with the underwriters and various city departments. At present Colorado Springs calls for conduit feeds in all classes of buildings and cabinets for all cut-outs. The new ordinance will, it is understood, make the requirement for conduit complete in all installations within the fire district and for all warehouses, schools, churches or buildings of a public character, including apartment houses, throughout the city. Within a year or two it is contemplated making a requirement for conduit in all buildings in accordance with the present Denver ordinance. Sign circuits are already required to be in conduit and steel boxing throughout this city, which construction is probably unique for a city of the size of Colorado Springs, which has a population of less than 40,000.

Gas Engine Plant in Buenos Aires.

BY J. P. STONE.

A NOTABLE instance of a complete steam-power plant being thrown out to be replaced by gas engines and producers is that of the power plant of the Buenos Aires (South America) slaughter houses. The whole of this equipment, comprising water-tube boilers, compound engines, generators and auxiliary machinery, is being dismantled and torn out to make room for gas engines, generators and producer plant. This steam station has been in operation nearly nine years, the original equipment being composed of two water-tube boilers, two horizontal-compound engines with their generators and two vertical-compound engines, another water-tube boiler being added later. All the generators were 120-volt belt-driven units. Power was principally used for lighting and pumping, but there were a few electric cranes. The plant gives a 24-hour service. Quite a novelty was introduced by employing two locomotive-type boilers as economizers, the gases after leaving the water-tube boilers passing through one or both of these boilers before reaching the chimney, which arrangement proved a very efficient water heater, as a steam pressure of 25 lb. could be generated by the heat from the waste gases.

The city engineers became interested in the use of gas engines some years ago, when two of the leading railway companies installed large gas-engine power plants to operate their workshops, the reliability of the gas engine as a prime mover being thereby firmly established. Prior to the installation of these two pioneer plants of large size, so little confidence was placed in the gas engine that no one would give it any consideration for important work, and such examples as these were necessary to assist in breaking down the prejudice and conservatism that existed.

When the general improvements in the slaughter houses were decided upon, which will greatly increase the consumption of electricity, it was decided to abandon the steam plant and put in gas. In February, 1908, the municipality called for tenders for the complete installation of two 250-hp and two 100-hp gas engines, each to be directly connected to their respective generators, together with the corresponding gas-producer plant of the pressure type, it being conditional that the contractors should remove the existing steam plant, install the new machinery, and

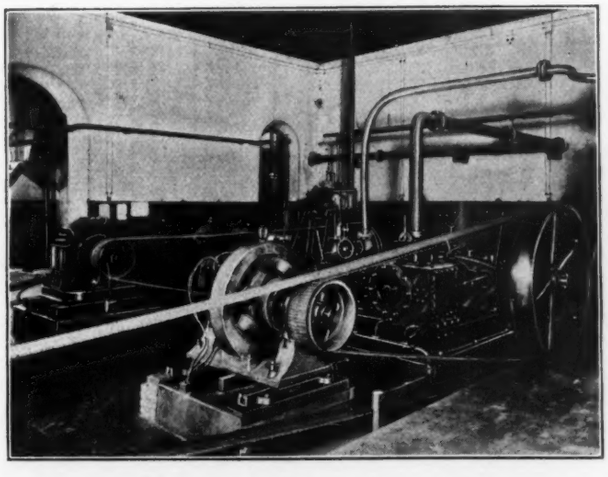


FIG. 1.—VIEW OF CORNER OF OLD ENGINE-ROOM.

put it in service without causing any interruption of the working of the plant. The specification also stated that the new machinery was to go into the existing buildings or, if that was not possible, the contractors had to provide the necessary enlargements.

The contract was awarded to Messrs. Agar, Cross & Co., Ltd., who are the agents for the Westinghouse Companies, and the Dowson Economic Gas & Power Company, their tender being the only one which fulfilled the conditions, which specified that the pressure type of producer was to be provided, all other competitors quoting for suction plants.

Before any work could be done it was necessary to remove the two boilers, two engines and generators, the principal exhaust main, and considerable steam piping, all of which was successfully accomplished without involving any interruption to the service.

A new temporary exhaust steam main had to be put in to take the exhaust out at the opposite side of the building, so as to leave the other side clear for the new work. The two 240-hp

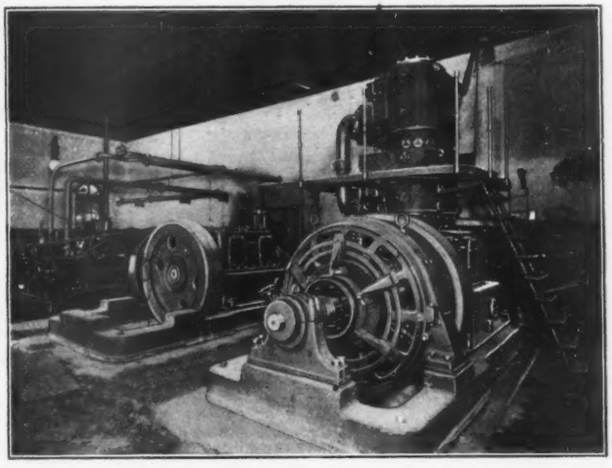


FIG. 2.—VIEW ALONG ONE SIDE OF GENERATING STATION, SHOWING GAS ENGINE PARTLY ERECTED.

gas engines are being erected in one half of the engine room. A view of the large gas engines partly erected is shown in Fig. 2, and the old steam engines can be seen in the background. As soon as the new engines are working the old steam engines now working in the other end will be removed and the 100-hp gas engines will be set up there.

The two 240-hp and the 100-hp gas producers have been set up in the boiler-room in the place formerly occupied by one of the water-tube boilers. It is expected that the gas engines will be operating under regular service conditions by the time this article appears.

Generators Designed for High Speed.

BY A. G. LANG.

THE adoption of high-speed generators directly coupled to steam turbines has resulted in something like a revolution in the construction of electrical machinery, and marks an epoch in the evolution of the electrical industry.

In addition to being at least the equal of the reciprocating engine as a prime mover, so far as the cost of operation is concerned, the steam turbine possesses a number of advantages over its older rival—for example, smaller space requirements, less weight and absence of any reciprocating parts and crank mechanism.

It may be said that steam turbines can be used for the operation of generators only in the case of a direct coupling of the two machines. While the relatively high speed of rotation of steam turbines afforded a decided advantage to the electrical industry in reducing the required dimension of the generators as compared with their output, it nevertheless resulted in a number of new problems, a solution of which could be found only after prolonged experience. Owing to the enormous centrifugal force, only high-grade material could be used, while specially skilled labor was required to produce an efficient turbo-generator. Another problem connected with the construction of turbo-generators was to provide for adequate cooling to dissipate

the very considerable heat produced. The rotary part of the machine is of small diameter, resulting in a very compact design and small cooling surface. Artificial cooling was, therefore, found to be indispensable. For this reason turbo-generators are frequently entirely enclosed, with the exception of a few parts,

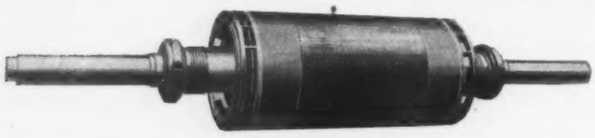


FIG. 1.—ROTOR OF 200-VOLT, 1020-KW, THREE-PHASE TURBO-GENERATOR.

such as the commutator and slip rings, while a part of the front surface of the rotor has been designed as a ventilator. Such turbo-generators are, therefore, also protected against the introduction of foreign objects, while any accidental contact of

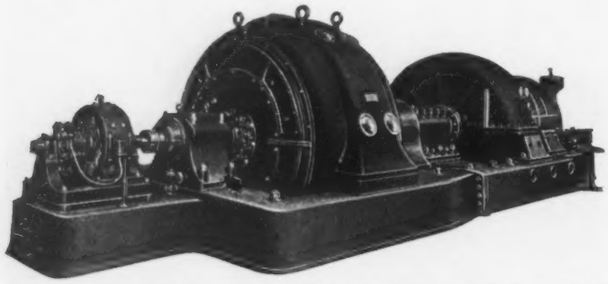


FIG. 2.—THREE-PHASE TURBO-GENERATOR, WITH DIRECTLY COUPLED EXCITER, DESIGNED FOR 6250 KVA.

current-carrying or rotating parts is effectively avoided. Moreover, the small diameter allows the centrifugal force to be kept within the proper limit.

In the case of single-phase or three-phase turbo-generators the rotor is the field structure which, in order to avoid any noise due to the high speed of rotation, is designed as a cylinder, as shown in Fig. 1. The field coils, which are embedded in slots, are secured against the effect of centrifugal force by metal wedges in the slots and by metal caps at the terminal surfaces. The exciting current is supplied to the rotor through carbon brushes. The armature coils, which are placed in micanite tubes, are anchored at the front surfaces by means of substantial blocks.

The continuous-current turbo-generator shown in Figs. 4 and

FIG. 3.—VENTILATED ARMATURE OF 500-VOLT, DIRECT-CURRENT GENERATOR.

5 is provided with commutating poles, and, if required, with compensating coils located in the faces of the main poles. The effectively ventilated armature, indicated in Fig. 4, carries a

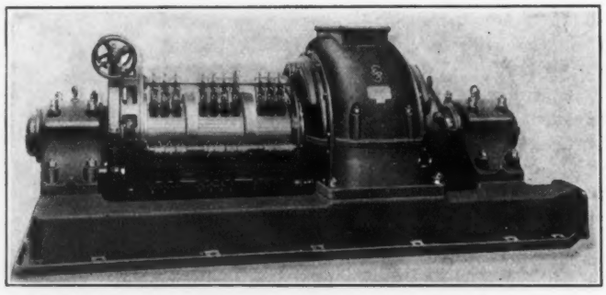


FIG. 4.—DIRECT-CURRENT TURBO-GENERATOR DESIGNED FOR 110 VOLTS, 1135 AMP AND 3000 R.P.M.

former made coil secured against the effects of centrifugal force by wedges and bronze caps.

Use is made of carbon brushes with a view to avoiding as far as possible any sparking while simplifying the operation. The commutators are ventilated by a strong air current, as well as by means of air channels arranged in the segments, or by special provision for heat radiation and conduction. The generators illustrated are of German design built by the Siemens-Schuckert Company, of Berlin.

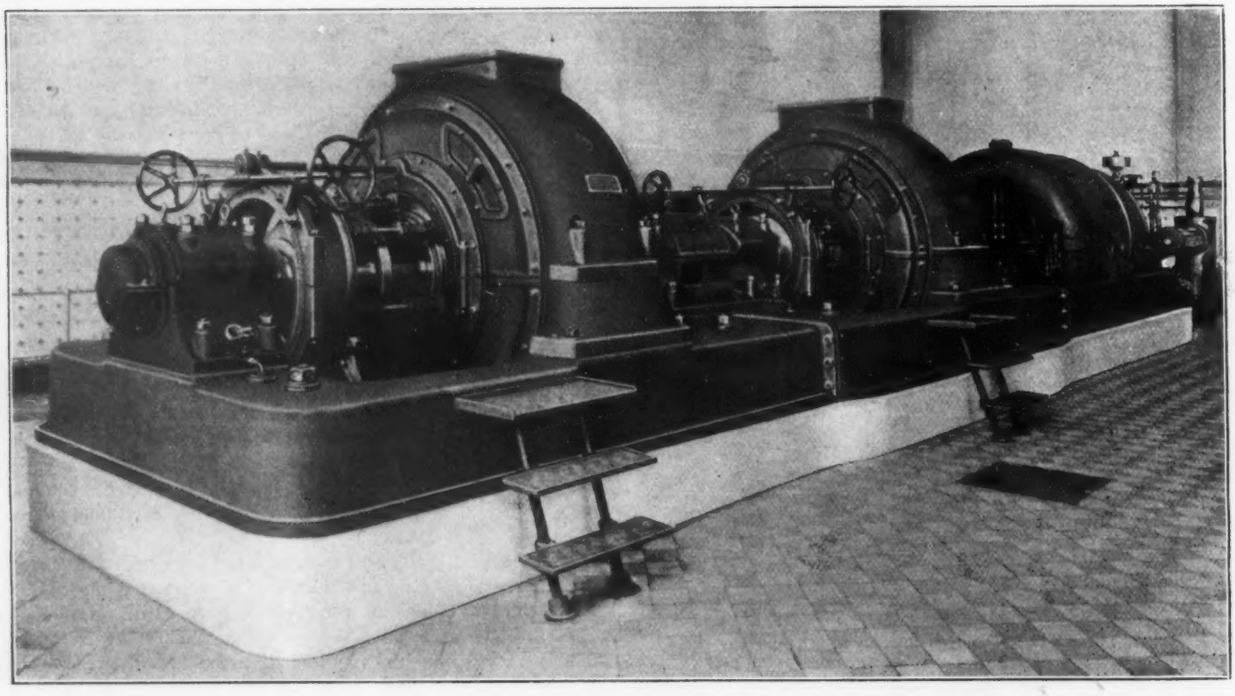


FIG. 5.—1950-HP STEAM TURBINE COUPLED TO TWO 500-VOLT, DIRECT-CURRENT GENERATORS.

The Grounded Secondary.

At the annual convention in Denver last week of the Colorado Electric Light, Power & Railway Association, Mr. W. J. Canada presented a paper entitled "Notes on Grounded Secondaries," of which an abstract follows.

The history of grounding was traced from 1885, when a proposition to ground the secondary met with strong resistance from the underwriters. As a compromise, a grounded shield between the primary and secondary transformer windings was adopted and used to some extent, but later abandoned, owing to trouble from its use. It also developed that a much more frequent trouble than transformer breakdowns was the falling of primaries on secondaries, or leaks between them through wet branches and the like. It became evident that both line and transformer troubles should be guarded against, and the ground on secondaries, still objected to by the underwriters, came to be generally accepted as the one real solution.

Injuries to persons, apparently and sometime undoubtedly, from higher voltages than are normal to inside wiring began to be more and more frequent. With the growth of a tendency to make operating companies responsible for such injuries these companies began to ground secondaries and to exert all possible influence with the underwriters to secure permission in the National Electrical Code for such connections. As the underwriters were the first objectors to grounding, whatever progress toward grounding has been made has meant a recession on their part from their original opposition. The 1901 edition of the "Code" contained permission for grounding and rules under which grounding should take place. This recognition of grounding applied only to the life hazard, the underwriters still maintaining that the grounding of one point on a secondary must necessarily increase the fire hazard. The number of service companies grounding the secondary grew rapidly from this time until to-day the great majority of companies throughout the country are operating in this manner.

The underwriters, originally tolerating ground connections only as safeguarding life, are now officially taking the neutral position of ignorance as to the relative fire hazard of grounded and ungrounded secondaries. Some few lighting companies still oppose it on the ground of needless initial expense, increased maintenance cost, and as probably increasing transformer troubles. Some companies even claim to consider, as the underwriters formerly did, that the fire hazard is increased by grounding. These obstacles to standardization of the practice of grounding are becoming daily less serious. The underwriters are finding fire losses from primary voltages on building wires more than balancing fire losses from local grounds inside buildings where low voltages only are concerned. Service companies are finding initial expense still an item, but not a prohibitive one, and all available records indicate that maintenance costs are rather reduced than increased, and that transformer troubles are much less. Opinion may be stated to be rapidly arriving at conviction that grounding is for our present form of alternating-current distribution a protection against life and fire hazards, and a necessary condition of reasonably safe operation.

To explain the attitude of the underwriters toward the grounding of secondaries when the matter was presented to them 20 years ago and their present hesitation to require grounding, the following letter from Mr. C. M. Goddard, secretary of the Underwriters' National Electrical Association, was, with Mr. Goddard's permission, quoted as representing his individual understanding of the matter and opinion.

"*First.*—When there is a ground on one side of any circuit only, it is, of course, conceded that no abnormal condition can result, but it requires two simultaneous grounds on opposite sides of the circuit. Therefore, there is, of course, a very much greater margin of safety when neither side is intentionally grounded, because to produce abnormal results an accidental ground must occur on each side of the circuit at the same time. With one side of the circuit permanently grounded the margin of safety is materially reduced, because in order to produce abnormal results a single accidental ground on the other side of the circuit at any time would be sufficient. This statement of the case will seem to be ample reason why, from a fire hazard standpoint, the ungrounded circuit is greatly preferable, and explains the objection of the underwriters to ground on the secondary.

"*Second.*—The improvement in transformer and circuit insulation, which has been secured as the use of electricity has increased, has, of course, materially reduced the probability of an accidental ground, and, therefore, has to the same extent modified the objections due to the increased fire hazard.

"*Third.*—The introduction of alternating-current systems with fairly high potentials on the primaries which have been so largely developed during the past few years has introduced, through the possibility of crosses between primary and secondary circuits and transformer breakdowns, what has been considered as a very serious life hazard, and the underwriters, who, in their electrical rules, have always taken the position that they must make no requirements against the fire hazard which would increase the life hazard, have modified their prohibition of grounds and have granted permission for grounding the secondaries under such restrictions as seemed necessary to keep the fire hazard at as low a point as possible.

"*Fourth.*—We think there is a considerable difference of opinion as to whether there is a greater fire hazard from the probability of primary current being communicated to secondary circuits than from the grounding of the secondaries. Personally, I am inclined to think that the two evils are pretty nearly balanced, although, as Code rules are more and more observed and installations of electric wiring improved, it is probable that the hazard from a grounded secondary may perhaps be less than an ungrounded secondary. However this may be, the life hazard which is guarded against by the grounded secondary should, I think, decide the question in favor of the grounded secondary."

The conditions usually stated as reasons for not grounding secondaries are, first, the difficulty in obtaining reliable grounds and the trouble and cost of maintaining them; and, second, the lessened factor of safety which exists in the transformer against breakdowns in electrical storms. Some companies claim this danger of breakdown extends to interior wiring installations, basing their claim, so far as known, upon incomplete theoretical deductions. Whatever the value of these objections they have been, barring the original veto of the underwriters, the one stumbling block in the way of absolutely standardizing the practice of grounding secondaries.

The validity of the foregoing objections to grounding may be tested by both theory and the experience of companies, and a few comparisons between grounded and ungrounded secondaries may illuminate the matter and clear away some common illusions.

As regards the proportion of lighting companies utilizing grounds, out of some 40 cities in this country fairly representing all parts of the country, 37 use grounded secondaries.

In the cities grounding no adverse criticism has been found. Of companies operating both systems, or which had formerly operated ungrounded, not one but preferred grounding from every standpoint, including a general reduction in maintenance and the quicker detection of minor troubles. Of those grounding not one reported greater trouble from transformer breakdowns. About half reported an improvement in service with the grounding of secondaries. On the subject of safety to life and property every company using grounds stated absolutely its confidence in grounding as a necessary practice for due protection to life and property.

As regards number of actual personal injuries and fires, while the total run high, it is almost impossible to give data with any completeness. In the case of accidents imputed to low voltages there is often possibility that primary and secondary have been in momentary contact, from swinging wires, static jumps in transformers, both frequent occurrences. We do know that 2300 is certain to be dangerous to persons if existing upon inside wiring. One hundred and ten volts or 220 volts

may be readily guarded against by the simplest precautions of employing ceiling lamps utilizing porcelain sockets and covering all live contacts generally in rooms with grounded surfaces.

There is no doubt that public sentiment is for the grounding, and that some of the damage suits based on this question have undoubtedly been decided on circumstantial and completely inadequate evidence. But, Mr. Canada states, there are numerous cases, many of which he has made notes of, where death certainly was due to 2300 volts on secondaries. Cases in point might be used in large number as illustration. And there is no case on record where suit has been brought for an injury to person occurring with grounded secondary, and such a suit would stand no chance at all.

With practice so strongly favoring the grounded secondary and with no positive reason for not grounding, it is interesting to examine in detail the defense offered for the ungrounded secondaries.

We may dispose, first, of the claim that there is greater fire hazard in building with grounded secondaries by the following considerations: Fire is caused in a building through electric wiring, by a short-circuit or by a ground where the building piping or material can come into circuit from any cause. The first cause, short-circuits, is not in any way affected by grounds, as the potential between wires in the secondary is in no way altered. The second cause, arcing grounds, is affected by the grounding of one point in the secondary circuit in one of two ways.

In the first place, if we ground one wire intentionally, an accidental ground at some portion of the interior wiring, and on the other side, is the only condition necessary for producing an arc at the point of the accidental ground. The circuit feeder and main fuse are in series with this ground to suppress it before it becomes of large proportions, but they do not prevent the arc, and the chance of arcing ground is much greater in this way than with both secondary wires ungrounded, as in this case an arcing ground can result only when two wires are accidentally grounded at one time, one of them within the building. This is the root of the past objection to grounded secondaries by the underwriters; but it is to be noted that the objection has been removed and that throughout the country the underwriters are *for* grounding. This arises from *other* causes of arcing ground within the buildings, which are becoming more and more of importance.

One of these other causes is the entrance of high voltage on ungrounded secondaries, to which an increasing number of fires are practically traced. This is so well recognized by service companies that two-thirds of those written on the subject assign the protection from fire hazard as a principal reason for grounding. It is almost certain that 2300 volts on ordinary interior wiring will cause damage, and ordinary 110-volt fuses are not reliable protection.

On the other hand, where grounded secondaries are used the accidental ground on an outer secondary, with the other side grounding, may be expected to blow the fuse in time to limit the arc and prevent fire. And it should be remembered, as three out of four of the above-mentioned service companies admit, that a large proportion of secondaries are in a permanent condition of accidental ground on one side or the neutral. This ground is ordinarily heavy enough to blow a circuit fuse, and it must, therefore, be admitted that this condition is equal in fire hazard to an intentionally grounded secondary.

When we add to this that two times out of three it is an outside wire of the ordinary 110-220-volt distribution which has this more or less permanent accidental ground, and the hazard is proportionately greater—at least four times, say—than with the middle point grounded, we can see plainly that it is not impossible that the fire hazard with ungrounded secondary might exceed that with them grounded. The average experience of the country indicates that this is really true and increasingly true; and underwriters, lighting companies and electrical engineers are all subscribing to this convention. We can, in brief, insulate with almost perfect safety from voltages of 110, or even 220, and our newer wiring installations do this. But we cannot insulate for 2200 volts in ordinary wiring, and we are not attempting to do so.

Other conditions constituting the defense for ungrounded secondaries are difficulties in obtaining thorough grounds and the prevalence of electrical storms.

The difficulty in obtaining good and permanent grounds is one of degree only; and in one method of grounding, and this the very best, all territories are alike in costs and thoroughness. This is the water-pipe ground, which should be made outside service switches of individual building services, or at foot of poles, or by continuous ground wire, tapped to secondary network and individual secondaries at frequent points and itself frequently grounded to water mains. This last method has in many cases proven the cheapest and most readily examined and repaired ground possible. It should be large enough to blow the primary fuse if necessary. This method may be as little as one-fourth or less the expense of individual building grounds. The individual building ground is now used exclusively by such companies as the Savannah, Toronto, Ottawa, Brooklyn, Providence and Boston service companies, among others. The Public Service Corporation of New Jersey makes this method of grounding standard in all the cities it serves. In a number of other cities this kind of ground is more or less frequently resorted to, but through no regular understanding with water companies or municipal water-works departments.

The grounding on water pipes is very rarely objected to by the water company where the nature of such a ground and its harmlessness to pipes is really explained. In most cities using other than water-pipe grounds the service company states that objection on the part of water companies is the only reason. This matter is now being brought before water-works engineers in a systematic manner so as to secure their active co-operation throughout the country.

As to the effect on water pipes of alternating current, Mr. E. E. Townsend, insurance engineer, of Chicago, writes: "Theoretically there is no danger whatever, and from my experience I have never known a pipe to be even slightly injured from such currents." Actual costs in grounding evidently have not proven in any manner prohibitive. Individual grounds are reckoned by one large service company to average about $10 to $12. Other companies approximate this same cost, and the grounding may usually be made at much less expense by selection of the services to be grounded. Three out of four companies find their costs in maintaining grounds more than offset by reduction in other troubles, such as fuse troubles in storms, meter registration accuracy, minor breakdowns on consumers' premises, and damage to buildings at fuse blocks or fixture canopies, etc.

In regard to lightning troubles, the damage to transformers is due to puncture of insulation between primary and secondary coils, or, as frequently, by breakdowns from primary to secondary cases and by the effecting dynamic current. The probable cause by which the transformer or line becomes the path is by its taking up the earth charge by slight leakage to a point nearer to the opposite atmospheric charge than is the earth itself. The discharge will be distributed through wires, trees or buildings, as they compare in area presented and amount of charge opposed to the atmospheric charge. This charge probably has nothing to do with the conductivity to earth, though the ease of the disposing of the charge is affected by this conductivity. Apparently the ultimate resistance from primary or secondary to ground through transformer is not the determining factor in the number of strokes. The secondary is close to ground potential and breakdowns occur in buildings when transformers are not grounded. The ground does usually save the building from fire damage, but does not invite the stroke. Of course, the better the ground the less the probability of building damage.

The well-grounded secondary may possibly assist in disposing of the discharge without any destructive effects, for it is a fact that of the number of companies reporting, those who have noticed any difference in their maintenance caused by ground-

ing claim that lightning troubles have been reduced by the grounding process. The protection to the building is considered by these companies to be very great, and the transformer to be in no way more subject to damage.

The frequent fires in buildings during electrical storms from unusual voltage on secondaries are also, so far as known, entirely in those cities where secondaries are ungrounded. In other words, experience has demonstrated the fact that the ungrounded secondary does not increase troubles due to lightning, but, rather, decreases them. An extension of this experience would be expected in a region of frequent electrical storms, surely not a reversal of the experience. And this experience covers companies operating with all sorts of grounds. The experience of companies seems to prove that grounding is in every respect practicable.

It may be stated both from theoretical considerations and from practical demonstrations in ordinary service, first, that the grounding of secondaries is thoroughly satisfactory as a means of preventing the entrance of abnormal voltages within buildings and the consequent fire and life hazard; and, second, that the grounding of secondaries is perfectly feasible from the standpoints of initial cost, cost of maintenance and the ease of obtaining thorough grounds, and, finally, it may be stated that lightning troubles are rather decreased than increased by grounding.

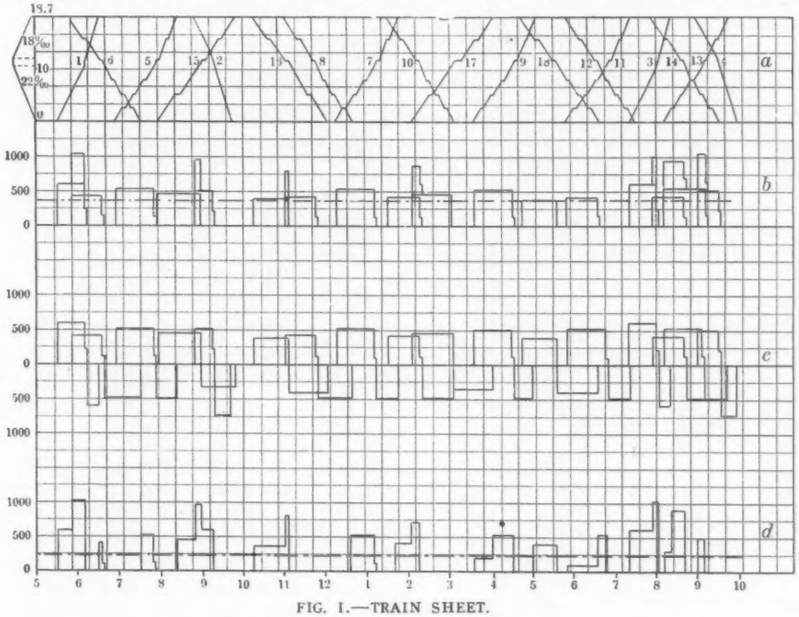


FIG. I.—TRAIN SHEET.

Together with the above it may be stated that grounding rarely increases the fire hazard in any respect owing to the accidental grounds frequently existing on secondaries, and the constant voltage of 220 instead of 110 volts to ground within buildings thus caused. It may further be stated that in only one case does this grounding fail to any extent in its protection. This is the case where a broken primary falls on the ungrounded or outer secondary and, the transformer being cut out by the breaking of the primary, the secondary voltage is raised to a point approaching that with an ungrounded secondary. The low resistance and impedance secondary coil in transformer will even then ordinarily blow the next primary fuse, but under certain assumed conditions might not. This is the case of a single transformer and independent secondaries. Interconnecting obviates this possibility, and the case would be far worse at any rate with the secondary ungrounded. It is, however, noted as the one partial exception to perfect protection by the grounded secondary for interior wiring.

The final conclusion of the paper is that the grounding of secondaries is to be considered as a necessary practice for the adequate protection of life and property, a measure opposed by no engineering society, and conflicting with no vital interest.

Traction System Using Constant Direct Current.

BY J. E. DALEMONT.

ALTHOUGH the series system using direct current may not lend itself readily to the distribution of energy, yet it might be suitable for long-distance transmission from one point to another without intermediary distribution. Several applications of this system have been made in the past in Europe, and these have been described in different periodicals. However, the advantages of direct high tensions over alternating high tensions were not sufficient to insure the success of the series system in cases where it would seem to be quite suitable. One might mention, for instance, the transmission from Bellegarde to Paris (200,000 hp, 500 miles), which was studied recently by André Blondel for a three-phase current at 150,000 volts and 25 cycles. The attention of the engineering world to the advantages of the series system of traction for mountain or high-grade lines has been aroused by the discussion held before the committee appointed to consider the electrification of the whole railroad system in Switzerland.

In spite of the numerous advantages of the series motor with constant current, as a traction motor, such as high efficiency at any load, it seemed difficult to employ it, not only because all of the machines, generating or receiving, would have to be placed in series, but also on account of the great loss in the line, which remains constant at any load. However, this motor, more than any other, provides for a convenient recuperation of energy on down grades, and this relation improves the efficiency of the distribution and justifies the use of this system on graded lines.

In order, however, to apply this system it was necessary to make a study of special apparatuses for the sectioning of lines, so that all of the trains running simultaneously would be placed in series. Further on it will be seen that the devices suggested by Mr. Potterat, engineer, of Berne (Switzerland), are not more complicated than many others in general use to-day in central stations. Mr. Potterat also studied the application of this system to a 32-mile heavy traffic line in the south of France, over which 15 200-ton trains run daily in either direction, and he has shown that it compares very favorably in every way with the single-phase system.

In what follows there will be considered a line of 18.75 miles, with light traffic and two grades of 2.2 per cent and 1.8 per cent converging to a plane of 1.25 mile, as shown in Fig. 1. Table I gives the speed in both directions, as well as the time of the different trains running on each section of the line. All of these trains are supposed to be composed of a 100-ton locomotive with tender, drawing cars aggregating in weight 200 tons.

TABLE I.

Trains number	Sec. 1: 10 miles Grade: 22‰		Sec. 2: 1.25 miles Grade: 0		Sec. 3: 7.5 miles Grade: 18‰	
	Speed m. per h.	Time min.	Speed m. per h.	Time min.	Speed m. per h.	Time min.
1 and 3.....	15	40	31	2.5	25	18
2 and 4.....	25	24	31	2.5	15	30
5, 7, 9, 11, 13....	12.5	48	21.5	3.5	18.5	25
6, 8, 10, 12, 14...	15	40	21.5	3.5	12.5	36
15 and 17.....	11.5	53	15	5	12.5	36
16 and 18.....	12.5	48	15	5	11.5	40

The traction forces in pounds per ton for the locomotive f_l and the cars f_c have been calculated by the following formulas:

$$f_l = 3.970 + 2.840\,V\,(1.6\,V + 50)\,10^{-3}.$$

$$f_c = 3.530 + 1.630\,V\,(1.6\,V + 50)\,10^{-3}.$$

Where V is the speed in miles per hour.

These forces as well as the total force applied to each train are shown in Table II on page 908.

Tables III and IV give, respectively, the horse-power corresponding to these forces and the power in kilowatts calculated on the basis of a mechanical efficiency of 0.80.

TABLE II.

Trains, No.	Section 1 Speed	Section 1 Grade	Section 1 Traction forces in lb.	Section 2 Speed	Section 2 Grade	Section 2 Traction forces in lb.	Section 3 Speed	Section 3 Grade	Section 3 Traction forces in lb.
1 and 3..	15	+.022	16,300	31	..	3,000	25	—.018	9,450
2 and 4..	25	—.022	12,100	31	..	3,000	15	+.018	13,700
5, 7, 9, 11, 13..	12.5	+.022	16,800	21.5	..	2,200	18.5	—.018	9,900
6, 8, 10, 12, 14..	15	—.022	12,800	21.5	..	2,200	12.5	+.018	13,500
15 and 17	11.5	+.022	16,000	15	..	1,760	12.5	—.018	10,250
16 and 18	12.5	—.022	12,900	15	..	1,760	11.5	+.018	16,000

In Fig. 1 curve *a* gives the course of all the trains in each direction; curve *b* is the total power consumed at every instant, assuming all the free energy in the grades to be consumed by friction brakes; curve *c* is the power consumed where recuperation in the grades is assumed; curve *d* is the actual quantity required in this case at the central station (not including line loss). In curves *b* and *d* the dotted lines show the average value of power for a given working time. It will be seen that these average quantities are, respectively, 480 kw without and 230 kw with recuperation.

Even if there be added in the latter case 60 per cent of the maximum quantity of power for line loss, the series system with recuperation will still offer a slight advantage.

LINE MATERIAL.

A short street-railway line supplied with constant direct current has been working for the past few years at Northfleet, near London, but the system adopted for feeding the car-motors in series was too expensive and not strong enough to be used. The line forms a closed loop, one branch of which is divided into short sections by switches, which the car opens automatically to introduce its motors in the circuit.

TABLE III.—POWER CONSUMED IN HORSE-POWER.

Trains, No.	Section 1	Section 2	Section 3
1 and 3.....	+658	+250	—635
2 and 4.....	—800	+250	+550
5, 7, 9, 11, 13.....	+565	+130	—500
6, 8, 10, 12, 14.....	—515	+130	+455
15 and 17.....	+500	+71	—344
16 and 18.....	—434	+71	+420

TABLE IV.—POWER CONSUMED IN KILOWATTS.

Trains, No.	Section 1	Section 2	Section 3
1 and 3.....	+605	+230	—582
2 and 4.....	—736	+230	+505
5, 7, 9, 11, 13.....	+520	+120	—458
6, 8, 10, 12, 14.....	—472	+120	+420
15 and 17.....	+460	+65	—316
16 and 18.....	—400	+65	+385

The ingenious contrivance of Mr. Potterat consists in placing alongside of the two trolley lines, divided in sections, a third continuous line, each section of which contains an automatic switch. This switch, which is shown in Fig. 2, is worked by a magnet fed by the current of the car passing over the section. Details of the automatic switch are shown in Fig. 3. It may be applied to a single track over which trains run in both directions. The two trolley lines *t*, *t'* are connected to the auxiliary conductor *c* by means of the commutator coils. The coils 1 and 3 draw the core upward, while the coils 2 and 4 have a downward movement.

When the first section is free no current exists in the commutator circuits, the contacts of which are in 1 and 4. If a locomotive runs to the left, its trolley passing on *t*, reaches the point of section x_2, and the current coming from *t'* through the motors, flows in coil 4, which attracts the cores downward, producing contacts in $n\,a'$ and $m\,b'$, while the current in coil 6 has the effect of opening the switch *i* in lifting its core. As soon as the second trolley reaches the point of section x_1 the current flows through the circuit $O_1 n'\,a'\,c$ of the automatic switch in section x_1x_2, and the result is that the switch of the last section—that is to say, the section before x_1x_2—falls and renews the connection of the auxiliary line. When the second trolley of the locomotive leaves the section x_1x_2 the apparatus resumes its first position and is ready for work again.

When the locomotive comes into the section from left to right, the commutator works in the same way, but the cores are now attracted upward and the contacts are made in $m\,b$ and $n\,a$. In the case of a sidetrack, four trolley lines will be cut at the points of junction. A second commutator will be placed be-

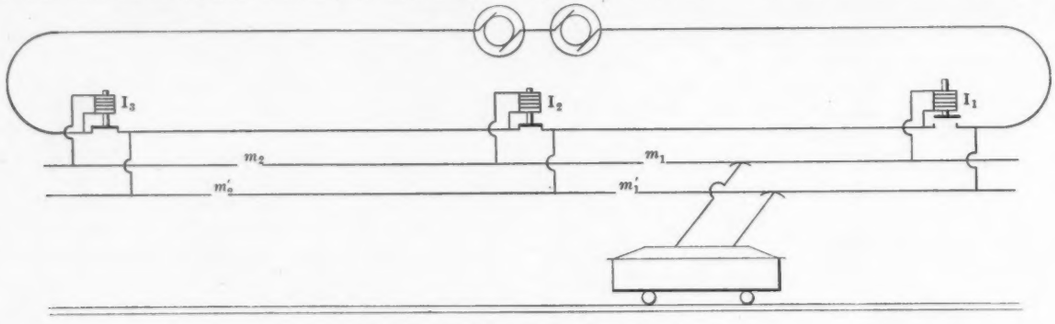


FIG. 2.—DISPOSITION OF TROLLEY LINES.

side the one on the first line, and the coils will be connected with the two trolley lines of the new track.

In these different workings the switches are opened when the current flowing through them has been sent in another road.

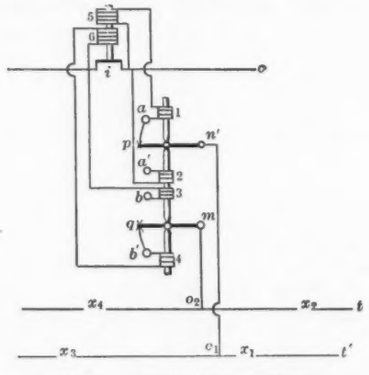


FIG. 3.—AUTOMATIC SWITCH.

The contacts, therefore, are not liable to deteriorate, and, if necessary, the commutator may be operated by hand.

The e.m.f. existing between the two trolley lines depends on the traffic, on the number of the locomotives running simultaneously and on the voltage adopted for each motor. Mr. Potterat, in the case of the Montrejoux-Tarbes line, adopted 10,000 volts between wires and placed the trolley lines outside of the tracks.

It is known that in the series system with constant intensity the regulation at the generating station is controlled by the e.m.f., which varies with the load. In the series system the trolley lines are under voltage during only the running time of a train, and the e.m.f. between the wires is not the same as that of the generating station. The result is that the setting up of the trolley lines in this system presents less difficulty than that of the three-phase system with constant e.m.f. It is not necessary here to go into the question of the suspension of lines

as it offers nothing of special interest. The system may be modified as required. It is well simply to call attention to the fact that the return of the current through the rails is cut off, and, consequently, the motor should be insulated from the truck. Mr. Potterat adopted for this purpose a motor with vertical axis set up in the box of the car and controlling the axle by the conical cog-system, shown in Fig. 4. The insulation of the framework of the motor from the axle is assured by an insulated elastic coupling enclosed in a box containing insulating oil. Although the e.m.f. of the motor may not be very high, the insulating e.m.f. between the wire and the ground is generally high and should be taken into consideration. As is well known, in order to set a motor running on a distribution in series it is only necessary to open a short-circuit switch. This is done without danger to the operator, without injuries to the apparatus, and without shock at the generating station. As the torque of the motor depends solely on the position of the brushes, the regulation of the torque and of the speed is obtained without rheostat by adjusting the brushes on the commutator. This greatly simplifies the arrangement of the locomotive circuits. Each motor requires one hand-operated short-circuiting switch, a crank for moving the brushes and an automatic short-circuiting switch, which

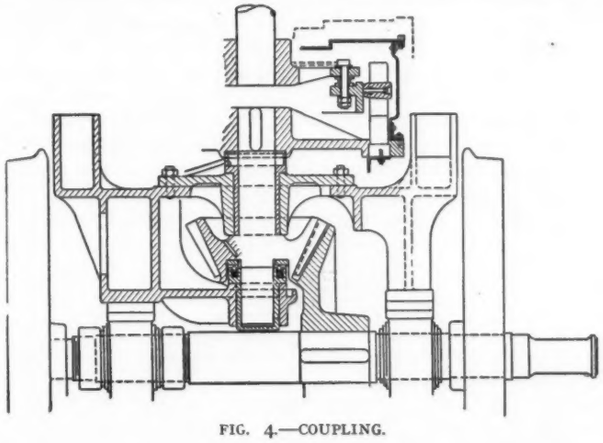


FIG. 4.—COUPLING.

acts when the brushes reach the nul point to cut off the current as the machine stops; an autotmatic switch for each high-tension circuit; an automatic speed-limiting switch.

The series distribution would be very inconvenient if all of the shunting had to be done in the station with the ordinary locomotives. But, as in the case of the steam engine, there is a tendency to use special small locomotives for this purpose, the same method may be resorted to in the case of electric traction, and this would do away with the distribution in stations, except for the principal tracks. In case of accident on the line, which must always be provided for, or, again, in the necessary shunting of big locomotives, Mr. Potterat suggests that each locomotive carry a 100-hp gasoline motor-generator, which could supply directly the necessary current to produce a reduced speed of the locomotive.

Finally, a very important advantage was pointed out in the case of trolley lines covered with a coating of ice or frost. The constant current would cause this coating to melt, and the chances of interruption in service are, therefore, reduced to a minimum. On the contrary, with the constant-potential system, the coating of ice may be sufficient to suppress the feeding of the motor and to stop the trains. As a matter of information, there may be added hereto the statements prepared by Mr. Bourdel in order to make a financial comparison between the single-phase and the series system.

	One-Wire Line.	Two-Wire Line.
Posts (53 per mile)	$1,030	$1,280
Trolley wire ½-in. in diameter (per mile)	724	1,450
Setting up (per mile)	320	640
Bonding of rails	320	.....
	$2,394	$3,370

If account be taken of the cost of setting up and the running expenses, one cannot but conclude that from the standpoint of economy, the series system might compare very favorably with the constant-voltage system. It now behooves traction engineers to study the advantages of this new system and the methods for its application.

Voltage Wave-Form of Delta-Connected Alternator.

By SHIRO SANO.

IT was shown by Prof. C. A. Adams recently before the A. I. E. E. that the voltage wave-form of an alternator depends on the style of winding of each phase and the way the phase windings are interconnected. It may be of interest to study in detail the case of a delta-connected armature with regard to the wave-form of the terminal voltage.

Let A, B and C represent the three separate phase windings of the delta connection. The induced e.m.f. in A may be represented by

$$E_1 \sin(\theta + \alpha_1) + E_3 \sin(3\theta + \alpha_3) + \ldots + E_n \sin(n\theta + \alpha_n) \quad (1)$$

Where E_n stands for the maximum value of the induced voltage of the nth harmonic; θ the angle changing with time; α_n the phase difference the nth harmonic makes with the combined wave.

The induced e.m.f. in phase winding B will be

$$E_1 \sin\left(\theta + \alpha_1 + \frac{2}{3}\pi\right) + E_3 \sin\left\{3\left(\theta + \frac{2}{3}\pi\right) + \alpha_3\right\} + \ldots + E_n \sin\left\{n\left(\theta + \frac{2}{3}\pi\right) + \alpha_n\right\} \quad (2)$$

The induced e.m.f. in phase winding C will be

$$E_1 \sin\left(\theta + \alpha_1 + \frac{4}{3}\pi\right) + E_3 \sin\left\{3\left(\theta + \frac{4}{3}\pi\right) + \alpha_3\right\} + \ldots + E_n \sin\left\{n\left(\theta + \frac{4}{3}\pi\right) + \alpha_n\right\} \quad (3)$$

The combination of the above three e.m.fs. will give the resultant e.m.f. acting in the closed series delta circuit, including windings A, B and C, which is

$$E_1\left[\sin(\theta + \alpha_1) + \sin\left(\theta + \alpha_1 + \frac{2}{3}\pi\right) + \sin\left(\theta + \alpha_1 + \frac{4}{3}\pi\right)\right] + E_n\left[\sin(n\theta + \alpha_n) + \sin\left\{n\left(\theta + \frac{2}{3}\pi\right) + \alpha_n\right\} + \sin\left\{n\left(\theta + \frac{4}{3}\pi\right) + \alpha_n\right\}\right] \quad (4)$$

The fundamental e.m.f. will vanish, while the e.m.f of the nth harmonic may or may not vanish according to the value of n. The above expression may be transformed into the following form:

$$\Sigma_n E_n \sin(n\theta + \alpha_n)\left\{1 + \cos\frac{2}{3}n\pi + \cos\frac{4}{3}n\pi\right\} \quad (5)$$

Let

$$K_n = 1 + \cos\frac{2}{3}n\pi + \cos\frac{4}{3}n\pi$$

The values of K_n for various values of n are tabulated as follows:

n	1	3	5	7	9	11	13	15	17	19	21	23	25
K_n	0	3	0	0	3	0	0	3	0	0	3	0	0

This shows that there exist harmonic e.m.fs. of the third and the multiple thereof in the closed circuit, while all other harmonic e.m.fs. vanish.

Now, let the combined resistance of windings A, B and C be R, and the combined reactance corresponding to the fundamental frequency be X; then, since the e.m.f. in the closed circuit is

$$3E_n \sin(n\theta + \alpha_n),$$

the current circulating therein will be

$$\frac{3E_n}{\sqrt{R^2 + n^2X^2}} \sin\left(n\theta + \alpha_n - \tan^{-1}\frac{nx}{R}\right) \quad (6)$$

The resistance and the reactance of each phase may be taken as $R/3$ and $X/3$, respectively. The voltage drop in one phase due to this circulating current and accordingly the terminal

voltage of the machine will be for the nth harmonic of multiple of three:

$$\frac{3E_n}{\sqrt{R^2+n^2X^2}}\sqrt{\left(\frac{R}{3}\right)^2+n^2\left(\frac{x}{3}\right)^2}\sin\left(n\theta+\alpha_n-\tan^{-1}\frac{nx}{R}+\tan^{-1}\frac{nx3}{R3}\right)$$
$$=E_n\sin(n\theta+\alpha_n). \qquad (7)$$

Thus it is that the combined e.m.fs. are exactly the same as those in any one phase winding.

The copper loss due to the circulating current will be

$$\frac{1}{2}\sum_n\left(\frac{3E_n}{\sqrt{R^2+n^2X^2}}\right)^2R=\sum\frac{9}{2}\cdot\frac{E_n^2}{R^2+n^2X^2}R \qquad (8)$$

where n must be taken as 3, 9, 15, etc.

In conclusion, it may be said that when the e.m.f. wave is distorted the delta connection has no effect upon the waveform of the e.m.f. and only causes an extra copper loss, which amounts to the value expressed in (8).

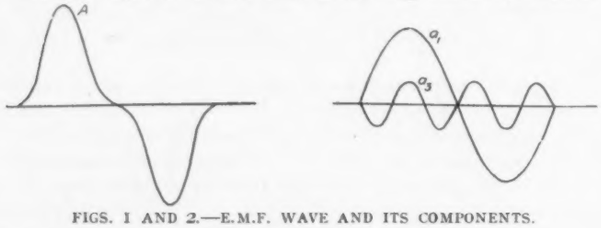
In star-connection the harmonics of the third and the multiple thereof disappear entirely without producing an extra copper loss.

Effects of a Third Harmonic in the E.M.F. Wave of a Three-Phase Generator.

By F. M. Denton.

It is a matter of common knowledge that the wave of open-circuit potential difference between the lines of a three-phase generator contains no third harmonic. This is the case, no matter what may be the wave shape of e.m.f. of each leg of the armature winding. If, for instance, the wave of e.m.f. due to one leg of a star-connected armature, or the e.m.f. due to one isolated leg of a delta-connected armature, contain a pronounced third harmonic, nevertheless the open-circuit line voltage of the machine when its armature is connected for three-phase, either star or delta, will be free from harmonics of the third order or any order that is a multiple of three.

A fact of some importance, however, and one that is sometimes lost sight of is this: that if the "leg e.m.f." of a three-phase generator contain a pronounced third harmonic, the armature winding ought to be connected in star and not in delta; the delta connection will entail the setting up of a circulating current in the armature winding, with consequent waste of energy and overheating.



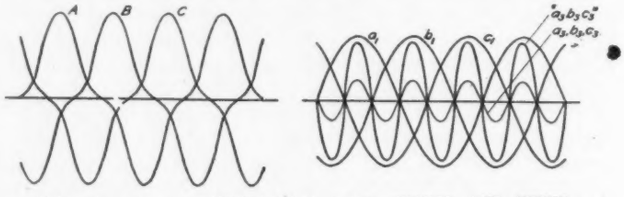
FIGS. 1 AND 2.—E.M.F. WAVE AND ITS COMPONENTS.

That this is the case may easily be shown thus:

Let Fig. 1 represent the wave of "leg e.m.f." of a three-phase generator, the wave when analyzed being found to consist of the fundamental and a third harmonic, as in Fig. 2. The wave shape of voltage inside the delta is found by combining three of these waves 120 deg. apart (Fig. 3). This is equivalent to combining three of the pairs of waves shown in Fig. 2, the fundamentals being placed 120 deg. apart (see Fig. 4). The result is to eliminate all the fundamentals and to add together all the third harmonics. The resultant triple amplitude third harmonic causes a triple frequency current to circulate around the delta.

To star-connect the armature of such a machine suffices, of course, to obviate the possibility of circulating currents. It at the same time eliminates the third harmonic from the wave of line voltage. For, let *OA*, *OB* and *OC*, in Fig. 5, represent the three legs of the star-connected armature. Then the wave-form of the e.m.f. generated in each arm is as in Fig. 1. The e.m.f. between *A* and *B* is the vector sum of the e.m.fs. in *OA* and in *OB*. The instantaneous values of the e.m.f. between *A* and *B* is found by combining two such waves as Fig. 1 placed 60 deg. apart, as in Fig. 6. This is equivalent to combining two of the pairs of waves shown in Fig. 2, 60 deg. apart (Fig. 7). The result is to eliminate the third harmonics and to produce as the line voltage a pure sine wave, having $\sqrt{3}$ times the amplitude of the fundamental of either leg voltage.

As regards wave shape of the line voltage, both star and delta connection produce the same result: they both eliminate the third harmonic. The wave shape of the line voltage of the delta-connected winding may be deduced as follows:



FIGS. 3 AND 4.—THREE-PHASE E.M.F. WAVES AND THEIR COMPONENTS.

In each arm the e.m.f. generated is equivalent to the fundamental and a third harmonic.

The voltages due to the third harmonic in *AB*, *BC* and *CA*, Fig. 8, are in phase with each other and in series, therefore they spend themselves in sending a short-circuit current around the delta. Between *A* and *B* one must consider the effect of the third harmonic in *AB* in conjunction with the effect of the third harmonic in *BC* and *CA*.

Now the product of the short-circuit current around the winding, into the impedance of the whole winding is equal to the total e.m.f. due to this third harmonic. Similarly, for each leg, the product of the short-circuit current into the impedance of the leg is equal to the e.m.f. due to the leg. Hence, there exists between *A* and *B*—as between any other two points in the delta—no difference of potential. The e.m.f. in *AB* is exactly absorbed by the impedance drop in *AB*. Similarly the e.m.f. in *ACB* is exactly absorbed by the impedance drop in *ACB*, and again there is no potential difference between *A* and *B*.

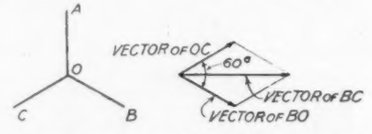
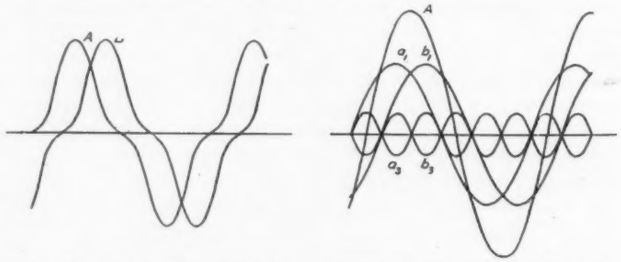


FIG. 5.—VOLTAGE IN STAR-CONNECTED ARMATURE.

The result is, therefore, that the third harmonic has no effect upon the voltage between *A* and *B*. The e.m.f. due to the fundamentals is, of course, sinusoidal; hence, the resultant line voltage is sinusoidal.



FIGS. 6 AND 7.—ELIMINATION OF THIRD HARMONIC BY 60 DEG. COMBINATION.

Thus it is that the wave shape of the line voltage is the same for the delta-connected as for the star-connected winding, third harmonics being in each case eliminated. (Some difference may be found, due to the reaction of the triple frequency short-circuit current upon the field flux, and, of course, if other harmonics besides the third are prominent considerable difference may be found.)

It is interesting to note that the so-called "open-delta" connection produces peculiar conditions of wave shape. The commercial use of the "open delta" connection is almost solely for transformers; in special cases, however, as, for instance, when one leg of the delta becomes damaged and has to be cut out, the open delta may be used for generators.

Let *CAB*, in Fig. 9, represent an open-delta connected winding—the leg *BC* being out of commission. It will be found that while, as would be expected, the voltages *AB* and *CA* are equal,

FIGS. 8 AND 9.—DELTA AND OPEN DELTA VOLTAGE VECTORS.

that across *BC* will differ from them by perhaps several per cent. And the oscillograph will show that while both *AB* and *CA* give singly a wave form like Fig. 1, the open arm *BC* will give a shape such as Fig. 10. The reason for this is easily seen. The wave shape over *BC* is ascertained by combining two of the leg waves (Fig. 1) placed 120 deg. apart, as in Fig. 11 *A* and *B*. This is equivalent to two pairs of waves, such as in Fig. 2, placed 120 deg. apart, as in Fig. 12—a_1, a_3 and b_1, b_3. The fundamentals a_1 and b_1 combine to form a wave similar to themselves as at a_1b_1, in Fig. 12, and the thirds have their amplitudes added together forming a resultant third of double amplitude a_3b_3, Fig. 12. This resultant third combines with the resultant fundamental to form the wave of line voltage *A* in Fig. 12.

In illustration of these points the author has made observations upon a three-phase alternator whose wave of flux exhibited a prominent third harmonic. The machine was of the ordinary revolving-field type, rated at 60 kva, 250 volts between lines, and 60 cycles. It had eight poles and two slots per phase per pole. The short-circuit current around the armature wind-

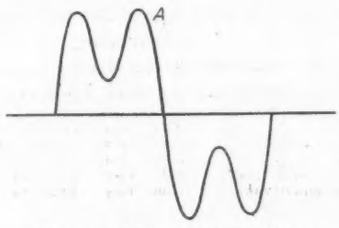


FIG. 10.—OPEN DELTA VOLTAGE.

waves *I*, *II* and *III* were observed simultaneously by means of the three vibrators of the oscillograph.

Curve *IV* shows the wave shape of three-phase line voltage; it is much more nearly sinusoidal than the wave of bar voltage (*II*) or even of leg voltage (*I*), the third harmonic having been eliminated.

Curve *V* shows the wave of voltage over the open leg of the open-delta-connected armature.

The shapes of these curves agree with the explanation given above. Their analysis up to the eleventh harmonic is shown in the accompanying table. For this analysis use was made of Prof. S. P. Thompson's schedule. The method is a simple and speedy one; all the figures used in the calculations are shown in the table, and the analysis of the five waves occupied less than two hours.

The curves being to small scale and their outlines thick, it is, of course, impossible to make an absolutely accurate analysis. In measuring the ordinates of the waves a fine pencil line was made down the middle of the thick photographic outline. The

	I	II	III	IV	V
	Y_1				
	3.40	1.60	6.00	8.60	9.20
	S_1				
	6.80	3.20	12.0	17.2	18.4
0.262	S_1				
	1.78	0.84	3.15	4.50	4.81
0.500					
0.707	S_3				
	21.2	19.8	20.5	28.4	27.2
0.866					
0.966	S_5				
	51.5	40.6	29.2	55.7	28.8
1.000					
1st col.	74.5	61.2	52.9	88.6	60.8
2nd col.					
SUM	14.9	11.9	10.7	17.6	12.0
DIFF.	-0.10	3.10	-0.70	1.00	1.70
$A_{1,3,5}$	100	100	100	100	100
11,9,7	-0.47	2.60	-0.66	0.57	1.42

	Y_2				
	9.10	5.00	12.3	15.3	15.0
	S_2				
	18.2	10.0	24.6	30.6	30.0
	S_2				
	9.10	5.00	12.3	15.3	15.0
	S_4				
	38.0	30.6	26.0	42.5	29.2
	S_6				
	27.5	22.5	15.3	29.8	14.9

	Y_3				
	15.0	14.0	14.5	20.1	19.2
	S_3				
	30.0	28.0	29.0	40.2	38.4
	T_1				
	-11.6	-7.63	7.63	0.14	19.1
	-20.9	-20.1	16.9	0.94	34.2
	-2.30	4.87	-1.67	-0.66	4.00
	-14.1	-16.9	15.8	0.84	28.5
	-1.55	4.10	-1.57	-0.38	3.34

	Y_4				
	21.9	17.7	15.0	24.6	16.8
	S_4				
	43.8	35.4	30.0	49.2	33.6
	Y_2				
	-9.30	-12.5	9.30	0.80	15.1
	-9.30	-12.5	9.30	0.80	15.1

	Y_5				
	26.6	21.0	15.1	28.8	14.9
	S_5				
	53.2	42.0	30.2	57.6	29.8
	S_5				
	13.9	11.0	7.90	15.2	7.8
	$-S_3$				
	-21.2	-19.8	-20.5	-28.4	-27.2
	S_1				
	6.58	3.08	11.6	16.6	17.9
	-0.70	-5.70	-1.00	3.4	-1.6
	-2.10	-8.90	0.60	6.00	-0.90
	0.70	-2.60	-2.60	0.80	-2.30
	-1.41	-7.40	0.56	3.40	-0.80
	0.47	-2.18	-2.44	0.46	-2.00

	Y_6				
	27.5	22.5	15.3	29.8	14.9
	S_6				
	27.5	22.5	15.3	29.8	14.9
	S_2				
	9.10	5.00	12.3	15.3	15.0
	$-S_4$				
	-38.0	-30.6	-26.0	-42.5	-29.2
	S_6				
	27.5	22.5	15.3	29.8	14.9
	-1.40	-3.10	1.60	2.60	0.70

ANALYSIS OF E.M.F. WAVES.

	I	II	III	IV	V
S_1	6.80	3.20	12.0	17.2	18.4
$+S_3$	30.0	28.0	29.0	40.2	38.4
	36.8	31.2	41.0	57.4	56.8
$-S_5$	53.2	42.0	30.2	57.6	29.8
$=T_1$	-16.4	-10.8	10.8	-0.20	27.0

	I	II	III	IV	V
S_2	18.2	10.0	24.6	30.6	30.0
$-S_4$	27.5	22.5	15.3	29.8	14.9
$=Y_2$	-9.30	-12.5	9.30	0.80	15.1

	A_1	A_3	A_5	A_7	A_9	A_{11}
	100	-14.1	-1.41	0.47	-1.55	-0.67
	100	-16.9	-7.40	-2.18	4.10	2.60
	100	15.8	0.56	-2.44	-1.57	-0.66
	100	0.54	3.40	0.46	-0.38	0.57
	100	28.5	-0.80	-2.00	3.34	1.42

	Y_1	Y_3	Y_5
	3.40	9.10	15.0
	6.80	18.2	30.0
	1.78	4.81	7.90
	21.2	27.2	13.9
	28.4	38.0	18.9
	51.5	69.0	34.2
	74.5	100.0	49.6
	14.9	20.1	9.94
	-0.10	-0.14	-0.07
	100	135	66.8
	-0.47	-0.63	-0.31

	Y_2	Y_4	Y_6
	9.10	15.0	21.9
	18.2	30.0	43.8
	5.00	8.60	12.5
	19.8	28.4	35.4
	24.8	37.0	47.9
	43.0	65.4	83.3
	61.2	88.6	113.8
	11.9	17.6	22.6
	3.10	1.00	1.70
	78.0	113.2	145.4
	2.60	0.57	1.42

	Y_1	Y_3	Y_5
	3.40	9.10	15.0
	6.80	18.2	30.0
	1.78	4.81	7.90
	21.2	27.2	13.9
	28.4	38.0	18.9
	51.5	69.0	34.2
	74.5	100.0	49.6
	14.9	20.1	9.94
	-0.10	-0.14	-0.07
	100	135	66.8
	-0.47	-0.63	-0.31

	Y_2	Y_4	Y_6
	9.10	15.0	21.9
	18.2	30.0	43.8
	5.00	8.60	12.5
	19.8	28.4	35.4
	24.8	37.0	47.9
	43.0	65.4	83.3
	61.2	88.6	113.8
	11.9	17.6	22.6
	3.10	1.00	1.70
	78.0	113.2	145.4
	2.60	0.57	1.42

ing when delta connected and giving a line voltage of 250 volts at 60 cycles was about 160 amp, a current just double the normal load current for which the winding was designed.

The waves were recorded photographically by means of a General Electric Company's oscillograph. The curves taken are shown in Fig. 14, *I*, *II*, *III*, *IV* and *V*. Curve *I* shows the wave shape of leg voltage of the machine; curve *II* the wave shape of the e.m.f. induced in each bar of the winding—this is similar to the wave of field flux; it was obtained by means of an auxiliary coil consisting of a few turns of thin wire wound

waves, and the amplitudes of their component sine waves, are as follows:

	A_1	A_3	A_5	A_7	A_9	A_{11}
Wave I—Leg voltage.....	100	— 14.1	— 1.41	0.47	— 1.55	— 0.67
Wave II—Bar voltage.....	100	— 16.9	— 7.40	— 2.18	4.10	2.60
Wave III—Third harmonic (to which is due the current circulating around the delta)..	100	15.8	0.56	— 2.44	— 1.57	— 0.66
Wave IV—Line voltage of star-connected armature.....	100	0.54	3.40	0.46	— 0.38	0.57
Wave V—Voltage across open arm of open-delta.....	100	28.5	— 0.80	— 2.00	3.34	1.42

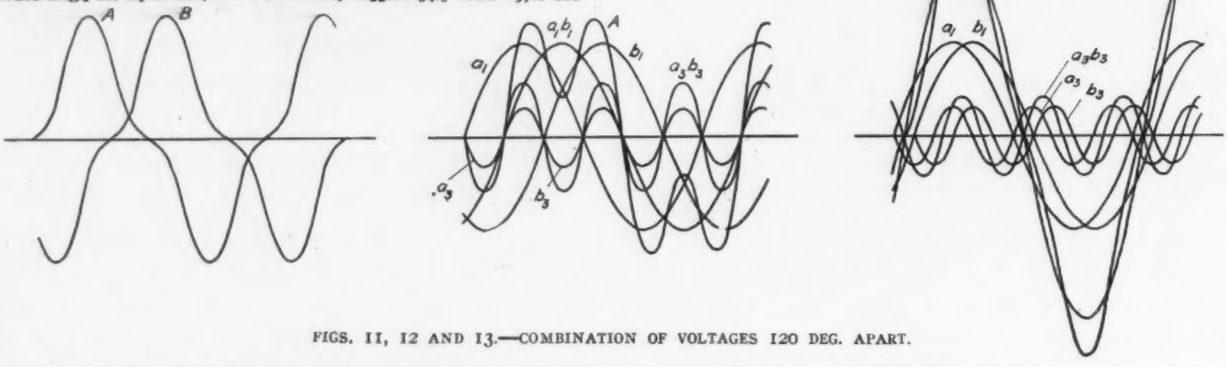
A_1, A_3, etc., are the amplitudes of the first, third, etc., harmonics, A_1 the amplitude of the first harmonic (fundamental)

having been reduced in each case to 100 for greater readiness of comparison.

The following points are brought out by the analysis: The wave of line voltage is nearly sinusoidal, all the harmonics being of negligible amplitude except the fifth, whose amplitude is about 3½ per cent of that of the fundamental.

Since there are two slots per phase per pole it should be possible to obtain Wave I by combining two of the waves of bar voltage (II) separated by the distance apart of two slots (30 deg.). This combination is carried out as follows:

	y_1	y_2	y_3	y_4	y_5	y_6	y_5
Wave II	1.60	5.00	14.0	17.7	21.0	22.5	21.0
Wave II, shifted 30 deg.	—1.60	0.00	1.60	5.00	14.0	17.7	21.0
Resultant	0.00	5.00	15.6	22.7	35.0	40.2	42.0
Resultant (y_5 set equal 100)	0.00	11.9	37.0	54.0	83.0	95.7	100
Wave I (y_5 set equal 100)	0.00	12.4	33.0	54.5	80.0	97.0	100



FIGS. 11, 12 AND 13.—COMBINATION OF VOLTAGES 120 DEG. APART.

y_1, y_2, etc., are the ordinates of the waves, to an arbitrary scale, measured every 15 deg. over one quarter-wave length.

The analysis shows that the amplitude of the third harmonic in II is —16.9, while that in I is —14.1. Reference to Fig. 13 will explain this: a_1, a_3, b_1, b_3, are the first and third harmonics, respectively, of two bar voltages set 30 deg. apart. The combination of the fundamentals a_1 and b_1 gives a_1b_1, while the harmonics give a_3b_3. And the combination of a_1b_1 with a_3b_3 gives A, the resultant wave of line voltage. The ratio of the amplitudes of a_3 and a_1 (the components of the wave of bar voltage) is about one to three, that is, about 33 per cent, while the ratio of the amplitudes of a_1b_3 and a_1b_1 (the components of the resultant wave) is only about 25 per cent. Thus, the amplitude of the third harmonic has been reduced from 33 to 25, a reduction which roughly corresponds with the actual reduction found, namely, 16.9 to 14.1.

The combination of two such waves as I set 60 deg. apart should produce IV, in which the third harmonic is almost eliminated:

	y_1	y_2	y_3	y_4	y_5	y_6	y_5	y_4
Wave I	3.40	9.10	15.0	21.9	26.6	27.5	26.6	21.9
Wave I, shifted 60 deg.	— 15.0	— 9.10	— 3.40	0.00	3.40	9.10	15.0	21.9
Resultant	— 11.6	0.00	11.6	21.9	30.0	36.6	41.6	43.8
Resultant (y_4 set equal 100)	— 26.6	0.00	26.6	50.0	68.7	84.0	95.2	100
Wave IV (y_4 set equal 100)	— 29.0	0.00	29.0	51.4	67.5	83.0	97.0	100

Reference to Fig. 2 will make it evident that y_3 of III must be subtracted from y_1 of IV; y_6 of III from y_2 of IV; y_5 of III from y_3 of IV, and so on as shown. These figures show only a fair correspondence. The inaccuracy is due partly to the neglect of the fifth, seventh and eleventh harmonics, for III contains only those harmonics in the wave of leg voltage whose order is a multiple of three, and partly to the fact that the third harmonic is shown to so small a scale that its ordinates cannot be accurately measured.

The combination of three such waves as I, separated by 120 deg., should give III:

	y_0	y_1	y_2	y_3	y_4	y_5	y_6
Wave I	0.00	3.40	9.10	15.0	21.9	26.6	27.5
Wave I, shifted 120 deg.	21.9	15.0	9.10	3.40	0.00	— 3.40	— 9.10
Wave I, shifted 240 deg.	— 21.9	— 26.6	— 27.5	— 26.6	— 21.9	— 15.0	— 9.10
Resultant	0.00	— 8.20	— 9.30	— 8.20	0.00	8.20	9.30
Resultant (y_6 set equal 100)	0.00	— 88.5	— 100	— 88.5	0.00	88.5	100
Wave III (y_6 set equal 100)	0.00	— 93.0	— 100	— 93.0	0.00	93.0	100

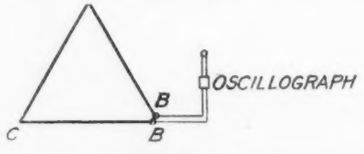


FIG. 15.—ARRANGEMENT OF OSCILLOGRAPH.

The last three rows in this table represent every third ordinate (y_0, y_3, y_6) of Wave III.

Two such waves as I, separated by 120 deg., should give V:

	y_1	y_2	y_3	y_4	y_5	y_6	y_5	y_4
Wave I	3.40	9.10	15.0	21.9	26.6	27.5	26.6	21.9

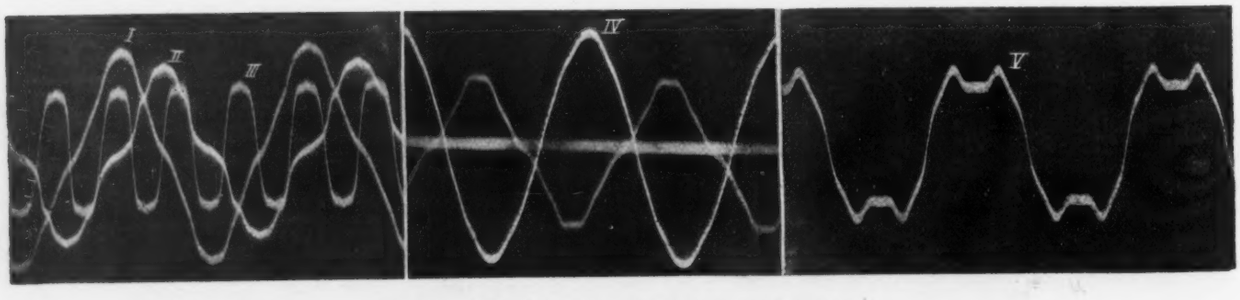


FIG. 14.—OSCILLOGRAM OF WAVES I, II, III, IV AND V.

The combination of IV with III should give I:

	y_1	y_2	y_3	y_4	y_5	y_6
Wave IV	29.0	51.4	67.5	83.0	97.0	100
Wave III, y_3 and y_6 (y_6 set equal 14.1)	— 13.4	— 14.1	— 13.4	0.00	13.4	14.1
Resultant	15.6	37.3	54.1	83.0	110	114
Resultant (y_6 set equal 100)	13.7	32.7	47.5	73.0	96.8	100
Wave I (y_6 set equal 100)	12.4	33.0	54.5	80.0	97.0	100

Wave I, shifted 120 deg.	15.0	9.10	3.40	0.00	— 3.40	— 9.10	— 15.0	— 21.9
Resultant	18.4	18.2	18.4	21.9	23.2	18.4	11.6	0.00
Resultant (y_1 set equal 100)	101	100	101	120	127	101	64.0	0.00
Wave V (y_1 set equal 100)	100	100	100	113	129	101	62.0	0.00

Hudson-Fulton Celebration in New York State.

THE greatest public event ever held in the State of New York was brought to a close Saturday night with a carnival parade in the Borough of Brooklyn and with a spectacular pageant in the city of Troy. Connecting the 160 miles between both cities was a chain of great signal fires 30 ft. high burned from heights along the Hudson River. An illustrated account of the celebration in New York City appeared in the Sept. 30 issue, but the celebration was not confined to New York City and the lower Hudson, for great preparations had been made by the various cities along the upper Hudson during the week just ended. The occasion was also utilized as a sort of Old Home Week for all of the towns in the Hudson Valley north of Newburgh, and many of the floats used in the historical pageant in New York City were used in the parades along the river towns. The celebrations in the towns and cities south of Newburgh took place on Oct. 1 and 2. Monday, Oct. 4, was Dutchess County day, with celebrations at Poughkeepsie; Tuesday the city of Kingston was visited; Wednesday, Catskill, the county seat of Greene County, was the center of attraction, and on Thursday the fleet moved on to Hudson. On Friday, the flotilla advanced to the capital city of Albany, and on Saturday, Rensselaer County celebrated in the city of Troy. Thus the celebration, extending from Sept. 25 to Oct. 9, and commemorating the three hundredth anniversary of the discovery of the Hudson River by Henry Hudson and the one hundredth anniversary of the inauguration of steam navigation on the same river by Robert Fulton, was brought to a close. While on account of the nature of the events commemorated and the necessity for a certain amount of concentration in order to make the event effective, the celebration took place along the Hudson Valley, the whole nation took a lively interest in it, and the presence of foreign warships and diplomats gave to the event an international significance. Certainly no commemorative celebration had ever before been undertaken on anything like as large a scale. As in New York City, so also along the entire route electrical illuminations played a very important part in the celebrations, and a brief description of the spectacular lighting in the various cities along the Hudson is given herewith.

YONKERS.

The electrical illumination in the city of Yonkers was especially attractive. The public lighting consisted of the following: City Hall, 3000 lamps; high school, 1500 lamps; public

FIG. 1.—STREET ILLUMINATION, YONKERS.

library, 1500 lamps; Manor Hall, 1200 lamps; public dock, 1000 lamps; public parks, 3000 lamps; Broadway, 3000 lamps; Main Street, 2000 lamps; Getty Square, 1000 tungsten lamps; fire headquarters, 500 lamps; police department, 500 lamps.

Manor Hall was the principal attraction; not gaudy or incongruous, the historic manor was the acme of taste in both decoration and illumination. The delicate tinted colors of the country under which Henry Hudson sailed were interwoven with the national colors, and the lines of electric lamps which outlined the building were only eclipsed by the simple but cordial illuminated word "Welcome" constructed of 7-ft. letters along the roof of the building. The triumphal arch erected in Getty Square presented a bright picture. The device con-

FIG. 2.—GETTY SQUARE, YONKERS.

sisted of a great wooden frame covered with canvas painted a dark drab color. On each side at the piers were portraits of Hudson and Fulton, and beneath the figures were the names in laurel wreaths, and above the dates 1609 and 1807. On the face of the arch were colored pictures showing the *Half Moon* and the *Clermont*. Between the piers and the arch were shields bearing the date 1909, surmounted by American eagles. At the capstones were paintings of the Angel of Victory. Some distance north and south of the arch were large white Corinthian columns capped with golden globes, and connected with the arch by strings of electric lamps. Similar columns were placed at the end of the street festoons; the whole representing what was known as the Court of Honor. From the river front charming pictures were presented by the Nodine Hill and Lake Avenue water towers, and a temporary tower on the site of the Hendrick Hudson Hotel, on Park Hill. Surmounting the top of the Nodine Hill tower were four large signs bearing the dates 1609 and 1909. The body of the structure was covered with colored lamps, which flashed on and off, giving the tower the appearance of a gigantic Roman candle. On the Lake Avenue and Park Hill towers red and green fires were burned for two hours nightly. The municipal building, on Dock Street, though not offering the same possibilities for artistic effects as Manor Hall, was fitted up in a pleasing style, and at night when the lamps were lighted its appearance was very attractive. The police headquarters is such a large structure that to embellish it fully would require quite an outlay, but the decorative material employed was put to good use.

The illumination of the bank buildings facing Getty Square vied with the glittering triumphal arch that spanned South Broadway. On the First National Bank there were three large signs bearing the name of the institution and the date of its organization, the latter being surmounted by a magnificent electrical sunburst. Beneath the sign was an American shield with a bull's-eye on either side. Strings of white lamps were strung around and across the frontage of the Yonkers Savings Bank. Festoons were hung in exquisite designs on the face of the structure, and extended around the columns of the entrance. The illuminated sign of the institution put the finishing touches

to the whole design, surmounted by a blazing crimson star. Similar strings of lamps were displayed on the Westchester Trust Company Building, a structure which requires little to enhance its appearance. The People's Savings Bank was also well illuminated. Covering the entire front of the Guinzburg Building was the monogram "H-F" in red, white and blue. The Westchester Lighting Company's office showed illuminations distinct from all of the others. The Odd Fellows' illuminated sign, strung across North Broadway opposite the lighting company's premises, helped to make the corner of Wells Avenue a great blaze of light. The whole water front glittered with the reflected light from the numerous lamps of the Ben Franklin Transportation Company and the boat club. The wharves and buildings of the company were outlined with nearly 2000 lamps and three giant signs formed the initials B. F. T. Co. The prettiest picture of all was the recreation pier scintillating with thousands of miniature bulbs, the ample decorations at times blowing over them so that the kaleidoscopic effects from the river were beautiful. The great sign of the Chamber of Commerce announced to those who plied the river in ships that this was Yonkers, and that right here were 80,000 people. Many buildings upon Main Street were beautifully decorated. Riverdale Avenue for many blocks was bright with flags and bunting and aglow with electric lamps. On the Radford Building, in Getty Square, were two big electric pieces representing the American and Hudson-Fulton flags in colors. A large number of business houses and even private residences in the city were especially illuminated at night. The offices of the Yonkers Electric Light & Power Company were especially attractive.

Above Yonkers, Hastings, Dobbs Ferry, Irvington, Tarrytown, Peekskill and Ossining celebrated without any elaborate electrical displays. At Peekskill and Ossining electric signs with the name of the town in 10-ft. letters were erected on the hillsides above the villages. One of the most beautifully decorated places was the residence of Isaac Stern, at Irvington-on-the-Hudson. The whole turret of his home on Broadway was wound with electric lamps, and the flag pole was a streamer of red. Across the river in Nyack and Hastings many buildings

FIG. 3.—NEWBURGH DAILY NEWS OFFICE.

were outlined, and here and there festoons with special columns, towers, etc., were in evidence.

NEWBURGH.

Newburgh is on the western bank of the Hudson, and perched upon lofty crags, pinnacles and peaks, so that most of the illumination was visible from Fishkill Landing on the opposite bank of the river. Moreover, the contour of the city added greatly to the picturesqueness of the illumination, in which approximately 30,000 4-cp lamps and 1000 40-watt tungsten lamps were employed. A feature of the illumination was the flame effect at the foot of South Street. This was produced on a structure 100 ft. long and 60 ft. high, on which 2000 lamps were in circuit. The sign flashed up like flames of fire, and then the word "Welcome" in 8-ft. letters appeared in white. The letters forming the single word were made up of tungsten lamps, while the other part of the device was illuminated with

FIG. 4.—CITY HALL, NEWBURGH.

lamps tinted a yellowish red. Five of the church spires in town were illuminated nightly with three rows of lamps running from top to bottom, and the effect, particularly from a distance, was very fine. The City Hall shone out beautifully; in the center of the top were the words "City Hall" in letters of fire, while strands of lamps ran up and down the building to the flagstaff. A feature of the decorations on the City Hall was the kaleidoscope of varying colored lamps which, with every changing variety, fascinated the pedestrians in the immediate vicinity. The *News* office also came in for a large share of attention. The Court House was among the public

FIG. 5.—HUDSON RIVER TELEPHONE COMPANY, NEWBURGH.

buildings illuminated. There were arches and festoons of lamps over the front of the building, and the face of the official reviewing stand, erected in front of the Court House, was also brightly illuminated. All along Grand Street, at intervals of 100 ft. or so, there were festoons of electric lamps with stars strung across the roadway. The picture, particularly viewed from Broadway and from South Street, was fairy-like. At the corner of South and Grand streets were representations of two American flags placed close together and studded with electric lamps. At Washington's headquarters a waving Ameri-

can flag 30 ft. long, with changeable stars for the flagstaff, was erected. This equipment called for 1000 4-cp lamps. The flag was placed half way up the flagstaff at the northeast of the historic structure. By means of a flasher a shimmering or waving effect was obtained. Inasmuch as this illumination could be viewed from a distance of half a mile, it was particularly effective. Ferry Square was ablaze with light. At the corner of Second and Front streets there is a very tall telephone pole which was made the most of in the decoration of that corner. At the top of this pole there gleamed electric stars in red, white and blue colors. From the apex of the pole were eight strings of lamps stretched out and downward in various directions until they reached a lodgment at the Dell House, the United States House, Cameron's lumber yard and other places nearby. Other stars and strings of lamps added to the effect. Second Street, from Grand Street down to Front overhead cross festoons as well as side festoons being employed. In the center set of columns was a large illuminated shell having on one side a picture of the *Half Moon* and on the other a picture of the *Clermont*, both outlined in electric lamps. Above each of the end squares formed by the pylons was an illuminated anchor at the center, and at the middle of each of the side festoons between each pair of columns was an illuminated disk bearing on one side the seal of the Hudson-Fulton Celebration and on the other that of the city of Poughkeepsie. Festoons of lamps were carried across Market Street from Cannon to the Soldiers' Fountain, being strung from tree to tree in a zigzag manner. At the fountain illuminated pond lilies in the basin and bands of colored lamps running from the centerpiece to the edge of the basin made a very pretty picture. On the way to the fountain the illumination of the Adriance Memorial Library Building by arc lamps and re-

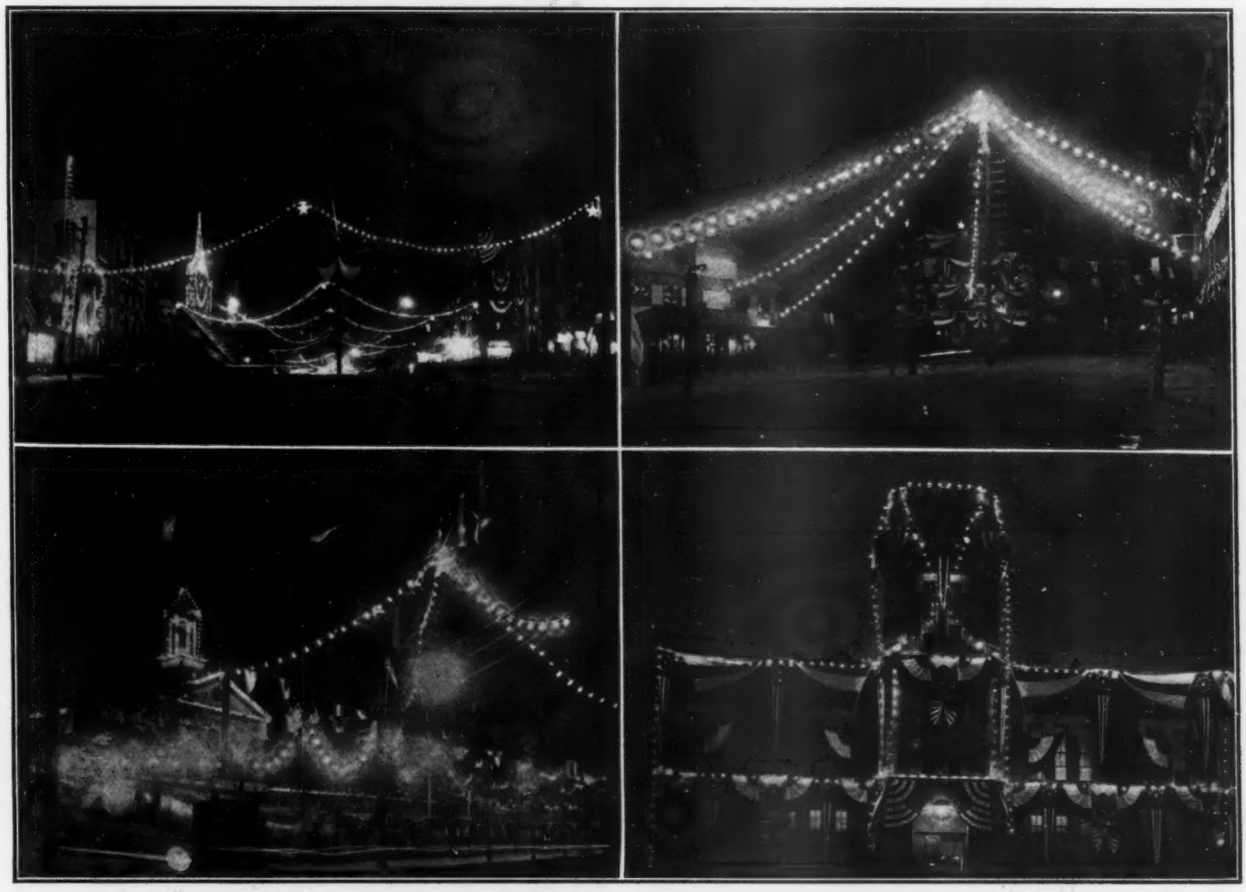


FIG. 6.—BROADWAY, NEWBURGH.
FIG. 7.—COURT HOUSE, NEWBURGH.

FIG. 8.—FERRY LANDING, NEWBURGH.
FIG. 9.—ARMORY, NEWBURGH.

Street, was festooned with streamers, and at the center of the various streets the streamers were caught up with double stars. At the end of each street, and the terminal of the decorations, double electric flags were hung. On Bayview Terrace there were streamers of 500 tungsten lamps outlining the terrace and a 20-ft. *Half Moon*.

POUGHKEEPSIE.

It is estimated that over 15,000 lamps were used to decorate the city of Poughkeepsie during the Hudson-Fulton celebration. The general scheme of illumination was very similar to that used during the convention of the Volunteer Firemen's Association of the State of New York, an account of which appeared in the Sept. 9 number. As was pointed out in that issue, the Court of Honor was identical with that used in Washington in connection with the inauguration. Some changes were made, however, in the electric setting, diagonal flectors was particularly noticeable. The chaste marble structure stood out in marked contrast to the blackness of the night, the scheme being somewhat similar to that employed in the illumination of Grant's Tomb in New York City.

The double strings of lamps along the curbs in front of the Post Office were taken down, and festoons running to the anchors and to the shell in a diagonal line across the street superseded them. Colored bulbs also formed a part of the changed decoration. On Main Street directly opposite Market Street, and facing the Court of Honor, was a large illuminated sign on which the words "Poughkeepsie Welcomes You" blazed forth. Running along the curb on either side of Main Street was a single strand of electric lamps, with festoons of lamps draped across the street so as to give the decorations a canopy effect. The wharves of the Day Line and Central Hudson Steamboat Company, as well as the ferry house and slip, were decorated and illuminated by means of flaming-arc

lamps. Lower Main Street below the New York Central Railroad station was lighted with flaming-arc lamps, and many of the public buildings, as well as business houses, were outlined in commemoration of the event.

KINGSTON.

Ulster County Day was celebrated at Kingston, the first capital of the State. The plan for illuminating this city was, briefly,

FIG. 10—MAIN STREET, POUGHKEEPSIE.

as follows: Four sections of the main thoroughfare, covering in all about 7600 ft., were lighted by streamers of lamps across the street every 100 ft.; there was a Court of Honor at the City Hall; large "Welcome" signs at the ferry depot, and also at the West Shore Railroad crossing of the main street, and an electrical waving-flag device at the corner of Fair and Main streets. The festoons were caught up by illuminated stars at the center, and approximately 10,000 4-cp lamps were utilized in the electrical decorations.

CATSKILL.

From Kingston the naval parade moved to Catskill, the county seat of Greene County, and the spot around which center many of the old Dutch traditions, notably the tale of Rip Van Winkle. At the ferry landing was a welcome sign and an anchor outlined with lamps, and the main thoroughfare leading from the landing to the center of the town was festooned with vari-

FIG. 11—COURT OF HONOR, POUGHKEEPSIE.

colored lamps. There was nothing remarkable about the illuminations in Catskill, since the appropriation for this purpose was very limited. The chief item of interest in connection with the celebration in Catskill was the trip planned by the Holland Society of New York in honor of the officers and men of the *Half Moon*. The party made its way to the mountain top, where the *Half Moon's* men had related to them in their native tongue the legend of Rip Van Winkle.

HUDSON.

Hudson, named after the explorer, and the county seat of Columbia County, held appropriate exercises on Oct. 7, and at night the city was illuminated. Warren Street from Public Square to Promenade Hill was a glare of light, and added to the electrical display of this street was the illumination of the Court House and Promenade Hill and the river front. On the flagstaff of Promenade Hill four flaming-arc lamps were burned, while at the steamboat dock were three more. Another flaming arc was used in Greene Street. About 40 festoons, containing approximately 1500 8-cp lamps, were fed from transformers on pole lines in Warren, Front, Ferry and Colum-

FIG. 12.—BROADWAY, KINGSTON.

bia streets, as well as in Park Place. A number of the bank buildings were also outlined in 16-cp lamps. The fire house of the C. H. Evans Hook and Ladder Company was covered with lamps, and the Elks' Club was also beautifully illuminated. The lamps on the street were festooned from pole to pole, and in order to keep the festoons across the center of the street away from the trolley wire they were elevated at the center by means of ropes fastened to the poles on the sidewalk.

Elaborate preparations were made in the cities of Albany and Troy, and as a result the illumination in both places was very surprising. The State, county and city buildings in Albany were dressed in appropriate colors, augmented by numerous incandescent lamps. The hill at State Street, from the river to the capitol, presented a very pretty sight, and this portion of the city was set aside as a Court of Honor. Festoons of varicolored lamps extended from pole to pole and at Pearl Street

FIG. 13.—COURT OF HONOR IN FRONT OF CITY HALL, KINGSTON.

four festoons of red lamps were caught in the center and held by the Hudson-Fulton initials spelled in light. The landing at Riverside Park was appropriately decorated and all the hotels, department stores, office buildings, theaters, etc., added to the gaiety of the scene by additional outline lighting.

Troy was even more elaborately decorated than the capital

city, and the illumination was not surpassed by that of any other city on the majestic river. There were many special decorations and illuminations of artistic design, American colors joining with those of the Hudson-Fulton festival, waving in an interchanging shade of light from lamps of various hues. In the public arches erected across the main thoroughfares 21,000 lamps were employed. The arch at Broadway and Third Street was studded with 3500 lamps whose rays fell upon a marvelously effective mingling of colors in the decorations. The official landing stage at the foot of Broadway was lighted by the rays of 500 lamps, and the approach to the city from the river was noticeably attractive. Congress Street Bridge was dressed in glorious colors from end to end and presented a splendid spectacle up and down the Hudson under the brilliance of 1000 lamps added to its regular service.

So general was the decoration that to cover it in detail would necessitate the publication of a list of business places in the heart of the Rensselaer County seat. The spirit of friendly rivalry in making the city beautiful was shown in all directions, and the public lighting at the intersection of the principal thoroughfares was very striking. Owing to the great pressure on our columns this week we are compelled to reserve that portion of the article treating of the illumination in Albany and Troy for the next issue.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Central-Station Power Load.

One of the most interesting papers presented at the recent meeting of the Pennsylvania Electric Association was a joint paper entitled "Power," which pointed out the value of a motor load to small central stations and indicated means by which such a load could be secured. Mr. T. E. Penrose, of Tyrone, was the editor of the paper, and in addition to contributing one section, added comments to the sections contributed by others. Mr. Penrose gave the results of tests at the Tyrone station of coal consumption in running a 500-kw turbine at different loads and for a different number of hours per day, the fires being banked for the remaining hours. Following are the results, the load factor applying to the period when the machine was in operation:

Load factor.	Hours run.	Coal per kw-hour.
1.00	2½	5.4 lb.
.90	7	4.4 "
.90	24	3.1 "

These figures, it was pointed out, clearly indicate how important a day load and high load-factor are to a central station.

Mr. J. W. Reeves said that the real cost of off-peak power business is so slight that for this business the charge per kw-hour can be much reduced, and yet the net profit increased. He said that his station at Johnstown had been making determined efforts to obtain off-peak load. A large isolated plant in a department store was superseded, adding to the station load 150 arc lamps, 1000 incandescents and 9 motors, with a total rating of 100 hp. Considerable of the lighting and all of the motors operate off the peak load. During the past two months the station has installed 27 motors, aggregating 222 hp, in a planing mill, replacing one 150-hp engine. Two small engines have also been replaced in a foundry with 10 motors, aggregating 100 hp, and one of the city laundries has been induced to install 16 motors, aggregating 28 hp, to replace a steam equipment. At present the company has on its circuits 504 motors with a capacity of 2611 hp. The Johnstown plant has a steam-heating auxiliary, and the increased load has caused a reduction in the amount of live steam required for this service. The amount of fuel consumed for both plants for an electrical output of 297,020 kw-hours was 3,222,640 lb., and when the electrical output was increased to 355,934 kw-hours the fuel consumed was only increased to 3,277,080 lb.

Mr. T. E. Spence gave figures showing the decrease of switchboard cost at the Plymouth, Pa., station due to taking on off-peak business. There was a total reduction in switchboard cost since March, 1907, of 0.195 cent per kw-hour, brought about by an increase of 734 hp in off-peak motor business. The load factor of this station has been increased from 20 per cent to 41 per cent in two years.

Mr. R. A. MacGregor, of the Easton, Pa., station, discussed methods for obtaining motor business. A motor solicitor, in presenting a case, should be well fortified with data from similar installations, and should become well versed in the details of the line of manufacture to which electric motors are to be applied. He should know what kind of motors to install and how to lay out an installation to the best advantage. Before presenting a case the solicitor should get up data as to the cost of operating by steam, of operating by electricity, of the cost of motor installation and the saving that may be effected, both direct and in increase of output. In commenting on Mr. MacGregor's paper, Mr. Penrose said that the motor solicitor can do more to reduce the kilowatt operating expense in 60 days than the whole operating force can in 10 years.

Mr. J. B. Kilmore, of Scranton, Pa., said the best examples of power business are city water-pumping plants running continuously and mine ventilating fans, which run at full load except when stopped for repairs. Closely approximating this class of business is that afforded in the silk industry. Although this business extends over the peak, yet the maximum demand is practically the average demand, the motors being started and stopped but once a week. Figures from a silk plant are given, showing that most of the motors, which vary from 2 hp to 50 hp, operate at practically full rated horse-power continuously, the load-factor ranging from 69 per cent to 100 per cent. In commenting upon Mr. Kilmore's paper, Mr. Penrose said that the high load factors there brought out should not influence one against low load-factor business. For example, a load made up of elevator motors, if there are enough of them, may give a very good average load owing to the diversity factor. Mr. Penrose said that blanks which he sent to lighting companies and to some of the manufacturers of electrical apparatus, asking for reports on motor installations, gave data which show that the cost of supplying a motor service is lower than is generally supposed.

Central-Station Commercial Development in Great Britain.

By Francis H. Davies.

While America is admittedly the birthplace of central-station publicity and commercial development as we know it to-day, and has well maintained the lead, the subject has by no means been neglected in England. The last three years have witnessed very remarkable progress. Many of the most staid of municipal bodies and the oldest of companies have awakened from their lethargy to institute new business departments, and the remainder are rapidly being forced into line by dwindling revenues occasioned by metal-filament lamps. The ways and means taken do not in the great majority of cases follow the American example closely, since conditions in Great Britain are very dissimilar and call for different treatment. Innate conservatism makes the task of pushing a new thing much harder, and if it is to go at all it must be pushed in the right way by steady, persistent effort rather than by aggressiveness as it is understood in America.

The British public is seldom to be hustled into anything; it is distrustful of all blatant advertisment, and looks upon electric light, gas and water undertakings as its natural enemies. It is, however, open to conviction, and does not mind being educated if the process be conducted in the right way, with all

due deference to its prejudices—which are, unfortunately, often very formidable obstacles. For these and kindred reasons it has been necessary for some time to feel the way very carefully and to determine how far it is expedient to follow the American precedent.

In the light of recent developments it appears curious that when the subject of publicity and systematic new-business work was first mooted in England many were found to condemn, root and branch, any but the old *laisser faire* policy of depending upon natural growth. Needless to say, such belonged mainly to the old school of professional engineer, the man who looks upon his calling more as a scientific pursuit than as a matter of business. In places, he still stems the tide of advancing commercialism, but on all sides there are indications of a new régime under which the man who extends the business, and by so doing makes it pay, will take the foremost position. Realization of this fact has doubtless been partly responsible for what progress has been made, but, of course, not entirely so. For many years past, in a considerable number of instances, commercial methods have been employed to increase business, but until recently they were anything but systematic. The germ, so to speak, has been lying dormant awaiting the impulse necessary to call it into life. That impulse came chiefly in the shape of a crusade in the technical press calling attention to the possibilities of a good commercial organization and quoting the American example, not necessarily for slavish imitation, but rather as an indication of what can be accomplished under one set of conditions. Several prominent English journals have each done yeoman service in the cause, and are continuing to further its interests in every possible direction.

So far as the writer is aware, the earliest really systematic effort was that of the Newcastle-Upon-Tyne Electric Supply Company, the management of which inaugurated an extensive new-business and publicity department in 1904. It is in active existence now and is the largest of its kind in the country. In comprehensiveness and organization the work of the Newcastle company compares well with that of the largest American new-business departments so far as one is able to judge from published accounts of the latter. For over three years the company issued its own monthly magazine entitled the *Tyneside Pioneer*, a publication noted for the quality of its matter and for its enterprise. A monthly bulletin is still issued, but it is now the product of the Electrical Press, Limited, and not the locally prepared article. All the usual publicity methods of circularizing, advertising, exhibitions, free trial of apparatus, etc., are employed, and at times the canvassing staff, which includes engineers capable of handling all branches of power and lighting work, has assumed very large proportions. On the whole, the Newcastle company's organization is very thorough and has proved eminently successful. The company's operations cover an area noted for its possibilities in the direction of energy supply.

The two municipal undertakings of West Ham and St. Marylebone probably afford the next best examples of systematic effort in business expansion. Their populations are, respectively, 308,000 and 133,000, and their annual outputs 11,299,783 kw-hours and 8,797,111 kw-hours, the former including 4,000,000 odd kw-hours sold for traction purposes. West Ham is an industrial area situated outside the jurisdiction of the London County Council. The undertaking has a large power load and great scope for increasing it, as the district is a popular one with manufacturers. Here, as at Newcastle, the organization is very complete and includes a showroom, a sales department and a large staff of canvassers. A quarterly publication, entitled the West Ham *Electrical Bulletin*, is circulated in the district with, it is stated, very good results. Printed on good paper, well illustrated and brightly written, it is certainly one of the best of its kind. It is quite impossible in a short review to detail in full the publicity and canvassing methods employed at West Ham. They, however, include newspaper advertisements, posters and enameled iron plates on signboards and public buildings, publicity circulars, pamphlets and postcards and many other recognized direct-appeal devices. Indirectly the work is forwarded by keeping in close touch with house and estate agents, builders and the local press.

On the subject of the St. Marylebone municipal undertaking, the writer—having until recently had charge of the publicity and canvassing department—can speak with more authority. The area is comparatively small, but it is very dense, consisting chiefly of the best class of private houses and large shops. Indeed, it is the complete antithesis of West Ham, and the lamp load far exceeds the motor load. The borough has been systematically developed for over three years, and all the usual new-business methods have been employed. A large showroom was inaugurated in the first instance and has always been a prominent and successful feature. As a seqquel to a course of circularizing, the principal part of the area has been canvassed street by street, and as a result the increase in new consumers and extensions connected has been very marked. A special feature was made of cooking demonstrations, the practice of the department being to instal the apparatus free of charge for a few weeks in any shop or restaurant suitable from the advertising point of view. This policy was found to arouse considerable interest in the subject and to assist materially in opening up new business in many directions by giving prominence to the supply generally. During the past three years a large number of pamphlets and circulars were published and regularly distributed. They were specially designed and compiled by the publicity staff, and a great deal of new business—particularly in heating—was directly traceable to their systematic use.

Of the 13 companies operating in London, the County of London Electric Supply Company and the Charing Cross & City Electric Supply Company are particularly noteworthy as having in active work properly systematized new-business organizations on a large scale. Practically all the remaining London companies are devoting attention to the work in varying degrees of thoroughness, and many of the municipal concerns have instituted, or are considering, publicity departments. In the provinces about an equal amount of progress may be recorded so far as important towns, such as Birmingham, Bradford, Bristol, Ipswich, Leeds and Sheffield, are concerned. These and a few others have for some time been developing their business upon commercial lines, but the majority of the smaller towns do not as yet evince a very progressive spirit. There are, of course, notable exceptions, but, on the whole, much remains to be done.

In Great Britain there is as yet little or no such co-operation as exists in America, a fact that is greatly to be regretted. There is decidedly room for some such organization as the Co-operative Electrical Development Association, and it is hoped in many quarters that the newly formed Electrical League—an association of men interested in electrical matters—may do something toward the desired end. In several directions there are indications of a desire for co-operative action, and some tangible steps were taken last year when the electric supply companies of London and a few of the local authorities jointly financed an electrical exhibit at the Franco-British Exhibition. The London supply companies have also combined in the production of a quarterly publication entitled the *Electrical Bulletin*, which has gained for itself a well-merited reputation and been closely imitated by the opposing Gas Light & Coke Company. A somewhat similar organization of London municipal engineers has issued several large posters of a striking nature. They are in evidence on signboards in many parts of London and have earned the distinction of being seriously objected to by the gas companies. Co-operative publicity does not extend beyond this, but its place is being to some extent filled by the Electrical Press, Limited, and one or two other concerns who are publishing a wide series of pamphlets, postcards and advertising matter generally, which is being distributed all over the country.

Cursory as the above details are, it will be seen that the last three years—more particularly in 1908—have been characterized by very considerable advancement. The stimulating effect of properly organized development work has commenced to make

itself felt in the case of the pioneers, and this is encouraging others to follow where they feared to lead. Much, indeed, remains to be done, but there is no doubt that the next year or two will witness remarkable developments in Great Britain which may be favorably compared with those of America, although perhaps along slightly different lines.

An English Central-Station Rate System.

By A. Hugh Seabrook.

I have been keenly interested in your issues giving accounts of tariffs recently adopted in several of your cities, and I enclose my recommendations for a revised tariff for the Borough of St. Marylebone, which have been adopted by the Borough Council.

After about 15 years' experience in electric supply I have come to the conclusion that flat rates of any kind are entirely wrong. Unless various classes of consumers are classified and a separate flat rate applied in each case, the flat-rate system is unfair; but a classification would be exceedingly cumbersome and likely to give rise to much dissatisfaction.

The greatest objection, however, in my opinion, is the fact that *no flat rate will induce long-hour uses of electricity.* It would not pay the proprietor of a store to illuminate his windows until midnight on a flat rate as low as 6 cents per kw-hour. The maximum-demand system, based on the "readiness-to-serve" charge plus a small charge per unit, is the only system which will induce consumers to be liberal in their use of electricity.

On the "telephone system" of charge, which, of course, is this "readiness-to-serve" system, a consumer, once having paid the annual charge, is induced to use electricity on account of the low price of 2 cents per kw-hour for lighting his windows until midnight, lighting up in dull weather, using electricity *only* instead of sometimes electricity and sometimes gas, because his annual charge once paid, the actual energy is practically given to him.

On one point I differ from the tariffs adopted in your country —namely, the running charge per unit. I stick to a level 2-cent rate for all purposes, but I notice that American central stations vary the running charge as well as the fixed charge. I would be glad to know what is considered to be the advantage of this variation, as at present it seems a departure from simplification, and one meter cannot be used for the whole of the premises for whatever purposes electricity is used, owing to this variation in the running charge per unit.

Our idea, with this tariff we are putting into force, is to induce a consumer to light completely his house with electricity and pay the extra $10 per annum for heating and other uses of electricity; because, when this total annual charge is paid, he can consider it fixed permanently (unless he rebuilds or extends his premises), and he can use electricity for any purpose he likes at 2 cents per kw-hour, which, I am convinced, will enormously lessen the difficulties of solicitors in introducing novelties and other apparatus for consuming energy.

The question will arise on reading the accompanying report that the kilowatt charge for heating and other uses of electricity is greatly lower than that for lighting. The lines we have gone along are that having obtained the lighting of the premises by electricity, we can afford to treat other uses of electricity as *additional output* and charge for that additional output in proportion to its cost, which is always considerably lower than the cost of the existing business.

In the particular case of this borough, we had to pay over $5,000,000 to the company to purchase the goodwill and right to supply, which is more than half our total capital expenditure; and whatever the increase in business we obtain in future, not a penny will be added to that $5,000,000. That is, of course, a somewhat extreme case; but it can be generally assumed that a system supplying, say, 10,000,000 kw-hours per annum can increase its output to 20,000,000 at a cost which is not at all in proportion to the cost of supplying the original 10,000,000.

Following is a reprint in part of the report submitted to the Borough of St. Marylebone (London) Electric Supply Committee by the writer, as general manager of the Marylebone municipal electrical supply system. After explaining the electrical terms used the report continues as follows:

Instance of a Typical Consumer.

A consumer who has in his house metal-filament lamps amounting to 1200 cp, consisting of, say, 40 30-cp osram lamps, will have a total power installed in his house of 1½ kw, or nearly 2 hp.

This consumer will not have his 1200 cp all going at one time, and his "average maximum demand" or "power required" will be about 750 cp, which is equal to 1 kw, or 1⅓ hp.

The Council Must Have Plant Ready to Supply the Consumer.

Now, for every such consumer requiring 1 kw connected to the mains (and consumers requiring other amounts of power—and all electrical apparatus require power—will be in proportion) the Council must have a kilowatt at their generating station in boilers, buildings, turbines, etc.—which plant costs a fixed sum to buy and to keep in order—ready to supply the consumer's kilowatt, or 1⅓ hp, at any time he wants it.

Cost to the Council of Being Ready to Supply a Consumer with a Kilowatt.

The cost of having the sum of these kilowatts ready at the station for the consumers is definite and ascertained, and the "kilowatt charge" or "annual charge" referred to in this report is based on that cost.

Cost to the Council of Supplying the Consumer with Kw-hours.

After this cost is covered there only remains the cost of supplying the units, or kw-hours, to the consumer, which is quite different from the "kilowatt" or "annual" cost, and is made up by coal, water, oil, repairs, wages, etc.; and the charge of 1 penny per unit, referred to in the report, is based on this cost, which is the only cost of supplying the actual units.

If a consumer only used his kilowatt for one hour in the year it would still cost the Council the "kilowatt charge" or "annual charge" to supply it, but one hour's use of the kilowatt would be one unit, and the charge for that would be 1 penny.

Comparison of Electric Supply with the Telephone Service.

The same thing exists precisely in the case of the telephone system. It costs the company a certain sum per annum per subscriber in capital, instruments, wires, cables, etc., to put the service into his house, for which the company charge an annual sum in advance, then the charge per call is 1d., which is operators' wages, management, accounts, repairs, etc. It costs the company this annual charge, whether the subscriber makes any calls or not, and the subscriber has to pay that charge whether he uses his telephone or not. If the subscriber makes a great many calls per annum, the average cost per call is a little over 1d. (1d. per call plus the proportion of the annual charge), because his load factor is high. If he only makes, say, one call per day, the average charge per call is high because his load factor is low.

Load Factor Apply Both in Electric Supply and Telephone Service.

In the same way, if an electricity consumer uses his kilowatt for many hours per year, his average cost per unit (proportion of annual charge plus 1d. per unit) is low, because his load factor is high. If he only uses his kilowatt for one hour per day his average cost per unit is high because his load factor is low.

The term "load factor" is, in the case of the telephone system, the percentage of the actual calls a consumer makes per annum to the maximum number he could possibly make. The maximum number he could make would be one every 10 minutes day and night throughout the year, equal to about 52,000 calls per annum. Suppose he actually made 20 calls a day throughout the year, he would make 7300 calls per annum, and his load factor would be 14 per cent made up by 7300 calls × 100 ÷ 52,000 = 14 per cent.

Likewise with an electricity supply, a consumer's load factor is the percentage of the actual hours per annum that he uses his kilowatt to the maximum he could possibly use it. The maxi-

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mum possible number of hours would be 8760 per annum, and suppose he actually used it for two hours per day that would be 730 hours per annum and his load factor would be a little over 8¼ per cent calculated as follows: 730 hours × 100 ÷ 8760 = 8.3 per cent.

The term "load factor" is not peculiar to electricity supply; it can be applied to any business. For instance, a restaurant keeper only doing a luncheon trade has a low load factor, but a saloon keeper doing business for seven days a week and 15 hours per day has a high load factor.

Proposed Tariff.

The following will be of further assistance in explaining the proposed tariff: 750 cp in metal-filament lamps is equal to 1 kw of "maximum demand" or "power required" and consumes one unit per hour. This applies also to 250 cp in carbon-filament lamps; 1 ordinary four-lamp radiator; 2 ordinary size flame-arc lamps; 4 electric irons; 16 small fans. Seven hundred and fifty candle-power would be approximately the "maximum demand" or "power required" of a 1100-cp or 1200-cp lighting installation.

Modification of Tariff.

I am now in a position to put before the committee a complete scheme of optional tariff suitable for all consumers. For the purposes of this report I will include again the large consumers from 50 kw and upward. Between 50 kw and 20 kw I call "medium-sized consumers." Below 20 kw I call "small consumers."

Tariff—Large Consumers.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
200 kw @	4 10 0	£900 0 0
175 kw @	4 17 6	853 2 6
150 kw @	5 5 0	787 10 0
125 kw @	5 12 6	703 2 6
100 kw @	6 0 0	600 0 0
75 kw @	6 10 0	487 10 0
50 kw @	7 0 0	350 0 0

Additional kilowatts, pro rata per kilowatt, or part thereof per annum; and 1d. per unit for all units consumed.

Terms.—Ten-year contract and exclusive use of electricity for lighting and power (motors). The "kilowatt charge" is payable annually in advance.

As an example of the above tariff, a consumer of 200 kw "power required" would pay £900 annually in advance and £4 10s. per annum for every kilowatt above 200 kw, plus 1d. per unit for all units consumed.

Tariff—Medium-size Consumers.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
45 kw @	7 9 6	£336 5 0
40 kw @	7 10 0	300 0 0
35 kw @	7 15 0	271 5 0
30 kw @	8 0 0	240 0 0
25 kw @	8 7 6	209 7 6
20 kw @	9 0 0	180 0 0

Additional kilowatts, pro rata per kilowatt, or part thereof per annum; and 1d. per unit for all units consumed.

Terms.—Five-year contract and exclusive use of electricity for lighting and power (motors). The "kilowatt charge" is payable annually in advance.

Under this tariff a consumer having 30 kw of "power required" would pay £240 annually in advance for five years, plus 1d. per unit for all units consumed.

General—Large and Medium Consumers.

With regard to these two classes of consumers, my intention is that these shall be minimum terms under these conditions and I do not want it to be considered an inflexible tariff. For instance, if it is inconvenient for a consumer to pay annually in advance, or to enter into a long-period contract, the "kilowatt charge" will be accordingly increased, taking into consideration the directions in which the consumer cannot meet our conditions; and I recommend that the Council (per their general manager) may offer an increased price if the consumer is unable to meet any of the conditions stipulated. I recommend also that the Council may at their discretion (per their general manager) ignore the "annual or kilowatt charges" for uses of electricity other than lighting and motors, provided the premises are lighted exclusively by the Council.

In all these cases of contracts the charge per unit will be payable within 10 days of demand, either weekly, monthly or quarterly, as may be required by us.

Small Consumers—Lighting Only—Telephone System of Charge.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
18 kw @	9 4 6	£166 10 0
15 kw @	10 0 0	150 0 0
12 kw @	10 10 0	126 0 0
10 kw @	11 0 0	110 0 0
8 kw @	11 11 0	92 8 0

Additional kilowatts, pro rata per kilowatt, or part thereof per annum; and 1d. per unit for all units used.

Power Required.	Per kw. £ s. d.	Maximum Fixed Annual Charge.
7 kw @	11 15 0	£82 5 0
6 kw @	12 0 0	72 0 0
5 kw @	12 10 0	62 10 0
4 kw @	12 15 0	51 0 0

Additional ¼ kilowatts, pro rata per kilowatt per annum; and 1d. per unit for all units consumed.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
3½ kw @	12 17 6	£45 1 3
3 kw @	13 0 0	39 0 0
2½ kw @	13 2 6	32 16 3
2 kw @	13 5 0	26 10 0

Additional $^1/_{10}$th kilowatts, pro rata per kilowatt per annum; and 1d. per unit for all units consumed.

Power Required.	Per. kw. £ s. d.	Minimum Fixed Annual Charge.
1¾ kw @	14 0 0	£24 10 0
1 kw		14 0 0
¾ kw		10 10 0
½ kw		7 0 0
¼ kw		3 10 0
1/10 kw		1 8 0

Additional $^1/_{20}$th kilowatts, pro rata per kilowatt per annum; and 1d. per unit for all units consumed.

The charges for all units consumed to be paid weekly, monthly or quarterly as may be required by us.

A large proportion of our present and future consumers will be 1 kw and under.

I propose that this tariff be known as the *telephone system of charging*, which is self-explanatory, as most of our consumers are telephone users and understand the fixed payment annually in advance and 1d. per call. If the telephone company charged 8d. per call for a certain number of calls, and 1d. per call for all calls after a minimum number, it would be equivalent to our 8d. and 1d. charges for energy. The fixed "annual charge" plus 1d. is preferable both in the company's case and in ours, and covers in our case exactly the same cost as the company's, viz., fixed charges, including the capital, and the 1d. is the running cost. These terms would be minimum terms. Any consumer wishing to pay quarterly in advance instead of annually would pay a correspondingly higher rental.

No contract for a number of years is necessary with these small consumers, unless any consumer particularly desires it, in which case there would be no objection from our point of view, and each case would be considered on its merits.

The annual charge to be paid annually in advance and based on the consumer's "power required" for the previous year.

For example, a consumer, whose "power required" for the past 12 months has been ½ kw would have the option of paying £7 down, plus 1d. per unit for all units consumed. That "annual charge" holds good for 12 months. At the end of the 12 months the "annual charge" is again fixed for the ensuing 12 months. If the "power required" has gone up or down during any year the "annual charge" will be altered accordingly for the next year.

In the case of new consumers, whose "power required" is not ascertained, the "annual charge" for the first year to be assessed by the general manager, and after the first year the same procedure as with old consumers.

The general manager to have power during any year to reassess the annual charge for that year as circumstances may warrant.

Flats—Farming Out Electricity.

The practice of farming out electricity to flatholders by flat-owners will have to be carefully looked into, because it is to flatholders I am looking for extensive use of heating and cooking apparatus.

Small Consumers—Heating, Cooking and Other Uses of Electricity, Excluding Lighting and Motors—Tariff.

I do not suggest any alternative to the 2d. and 1d. maximum demand system for consumers using motors—*i.e.*, factories, etc., at present.

I recommend the following scale of charges for heating, cooking and other uses.

Power Required.	Fixed Annual Charge.
¼ kw	£0 5 0
½ kw	0 10 0
¾ kw	0 15 0
1 kw	1 0 0
2 kw	1 10 0
3 kw	1 15 0
4 kw	2 0 0
5 kw and upward	2 2 0

And 1 d. for all units consumed payable weekly, monthly or quarterly, as the Council may require.

Terms.—The "kilowatt charge" payable annually in advance.

The scale for heating and other uses of electricity only applies where the lighting of the premises is exclusively electricity from the Council's mains.

These terms again are minimum terms; any consumer who wishes to pay quarterly instead of annually will be charged a correspondingly higher rental.

For uses of electricity under this tariff we can generally assess the apparatus itself—*i.e.*, a four-lamp radiator would be £1 per annum, and five radiators (or their equivalent) would be £2 2s. 0d., and so on.

General Remarks—All Sizes of Consumers.

We have had to settle the tariff of the large consumers because, as the committee is aware, the matter was urgent When reporting on these I was not in a position to report upon the whole of the optional tariff down to the small consumers.

I have now been able to give the matter very serious consideration, and am satisfied that we shall do better with our existing consumers with a simplified tariff; that it will be easier to get additional lighting business, and that with the proposed rate for heating and cooking, etc., we can compete with gas.

Inspection.

Under this tariff the consumer must give all facilities for inspection of installations and apparatus by duly authorized officers of the Council periodically.

One advantage of this "annual charge" plus 1d. per unit tariff is that one meter only is required, the "power required" or "maximum demand" indicator remaining on all premises as at present, as the whole tariff depends upon the "power required" or "maximum demand."

Generally—As Regards Flat Rates.

I am of opinion that flat rates as a rule are incorrect methods of charge, and I would not recommend an extension of such rates for this district. The only fair method of charging on the flat-rate system is to group various classes of supply and give each class of supply a different flat rate according to load factor, which would result in no end of dissatisfaction among consumers.

Generally—As Regards "Maximum Demand" System.

The "maximum demand" or "power required" system of I think, meets this difficulty. The variation in "annual charge" as between large and small consumers differentiates between wholesale and retail supplies. The "annual charge" plus 1d. per unit automatically gives a low average price per unit to the desirable long-hour consumer with high-load factor, and likewise a high average to the short-hour user with low-load factor, who is much more costly to supply. The annual payment in advance for large and medium consumers lessens the risk of bad debts to the Council, and further, in the case of small consumers, renders deposits unnecessary.

General—Saving in Duplicate Wiring.

A most important point to the consumer is that one set of wiring only is necessary in all premises, even where lighting, heating and cooking are mixed up. This is a considerable saving to the consumer, and one which the Council, in the past, has been endeavoring to effect by means of plug meters for heating, etc.

"Maximum Demand" or "Power Required" Indicators and Meters.

Under this proposed tariff, these indicators will only require to be read in the months of October, November, December, January and February. The fact that this tariff saves meters does not make much difference from our point of view, because meter rents are charged. Under the proposed tariff, meter rents, connection charges, inspection charges, etc., all remain as at present.

Definition of Power, Lighting and Other Uses of Electricity.

As to what may be termed "lighting," "power," "heating," "cooking" and other uses of electricity, the general manager's decision must be final.

Application of Tariff.

Any consumer wishing to avail himself of this optional lighting tariff must have the whole of his lighting on this system; but I recommend that any consumer, no matter the system he elects to be charged upon for lighting, can have the new "heating" and "cooking" and "other uses" rates, provided he puts in separate wiring for such uses, and uses exclusively the Council's electricity for lighting. The cost of separate wiring will, in any case, be an inducement to the consumer to take the "telephone system" of charging right through.

INTERIOR WIRING AND ILLUMINATION

New Decorative Lighting at the Alaska-Yukon Exposition.

On Sept. 18 the dome of the main government building at the Alaska-Yukon Exposition was lighted for the first time. The effect is very fine, as there are nearly 10,000 lamps on the dome and the intensity of illumination is such as to make it plainly visible from the many hills of Seattle even several miles

FIG. I.—GENERAL VIEW OF COURT-OF-HONOR ILLUMINATION, ALASKA-YUKON EXPOSITION.

distant. The dome lighting completes the decorative electrical effect of the main Court of Honor as originally planned, and

the completion of the work at this late date is due to the fact that the Government appropriation did not become available for this purpose till Sept. 6. The exposition management let the contract at once and within 10 working days had over 10,000 lamps in place, although some of the construction material had to be shipped from San Francisco. The lighting scheme is in accordance with plans of A. J. Quigley, assistant

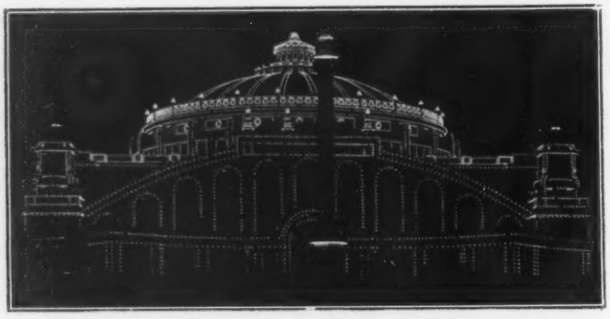


FIG. 2.—GOVERNMENT BUILDING ILLUMINATION.

electrical engineer of the exposition, and under his supervision the work was done by Agutter Griswold Company, electrical contractors of Seattle.

The pictures herewith show the marked change that has resulted because of this additional lighting. The architectural ornamentation of the dome was such as to lend itself well to electrical outlining. The ball of fire on top, the two crown-like cappings below and the parapet wall at the base of the dome proper are all particularly beautiful at night. It is greatly to be regretted that the work could not have been done before the thousands of visitors from the East had come and gone.

Illumination of Shop Yards by Means of Tungsten Lamps.

By Arthur Gillman.

Multiple tungsten lamps find an ideal application in the illumination of industrial-plant yards. It will be found that in many cases a 250-watt tungsten lamp can be substituted for an enclosed-arc lamp with very satisfactory results. One simple way of installing a unit out of doors is given in Fig. 1. Rubber-covered leads convey electricity from the main conductors to a porcelain or composition weather-proof socket which carries a brass shade holder and a tungsten lamp. An

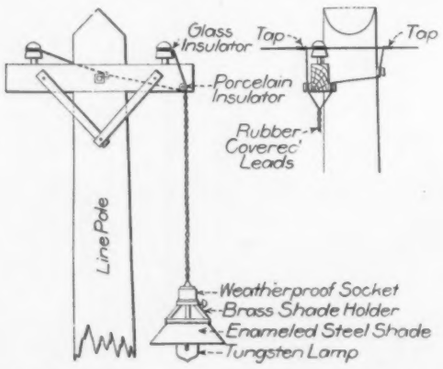


FIG. 1.—TUNGSTEN UNIT SUPPORTED ON POLE.

enameled steel shade or reflector, white inside and black or blue outside, held in the shade holder with binding screws, serves to protect the lamp and to deflect the light in a useful direction. There are several types of shade manufactured which satisfy the above general specification, and being of different forms provide different light distributions. Some makers are prepared to furnish curves showing the distributions rendered by their different reflectors, and from these the best type to meet any particular condition can be selected. In Fig. 1 the rubber-covered leads from the main conductors to the weatherproof socket are insulated from the cross-arm on which they hang by porcelain knobs held thereto with wood

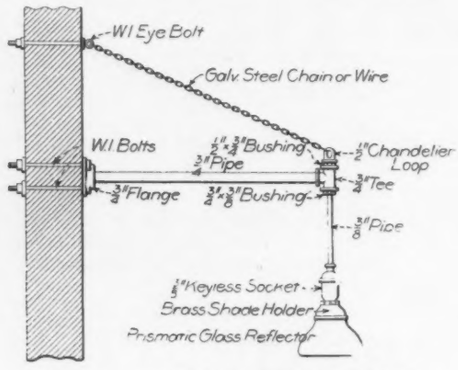


FIG. 2.—HOME-MADE OUTDOOR FIXTURE.

screws. Little trouble is experienced in out-of-door work from filament-breaking vibrations, but in an installation such as that shown in Fig. 1 the lamp should hang far enough away from the pole to prevent its striking during a gale. Compare the arrangement in Fig. 1 with that involving an arc lamp for simplicity, reliability and economy.

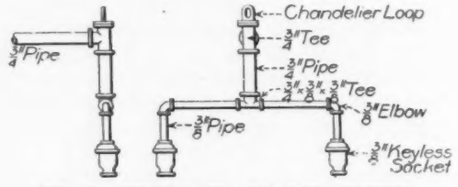


FIG. 3.—FIXTURE FOR 220-VOLT CIRCUITS.

A home-made out-rigger carrying a tungsten unit is illustrated in Fig. 2, as mounted on the outside wall of a building. All of the components in its construction are commercial and one can readily be assembled at low cost by a wireman. This being a side elevation only one steadying chain appears, but there are

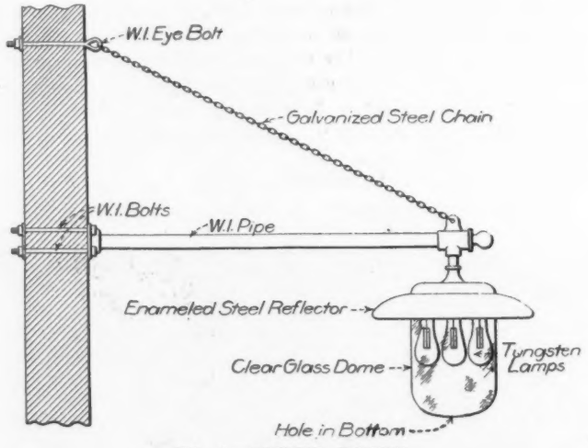


FIG. 4.—OUTDOOR CLUSTER.

two. The lower end of each engages in the chandelier loop and the upper ends are secured, each in its own eye-bolt, several feet apart, horizontally, on the wall. No provision is shown for damping vibrations, as such seldom exist in a location like that shown. Conductors to the lamp can be carried inside the 3/8-in. pipe up to the outrigger pipe and inside of it to the in-

terior of the building. A prismatic glass reflector is shown on the lamp. Glass reflectors particularly designed for street illumination are manufactured for use with series tungsten lamps, but they can be adapted to multiple installations and should give satisfactory results for industrial-plant yard lighting.

In plants where current at a tension of 220 volts only is available and it seems desirable to operate two 110-volt lamps in series across this, the fixture shown in Fig. 2 can be adopted for 220 volts, as detailed in Fig. 3, which shows only

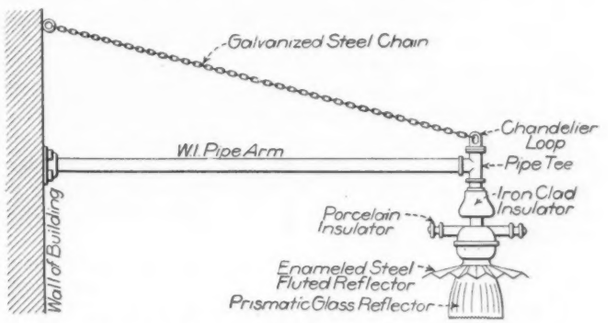


FIG. 5.—A SERIES INCANDESCENT ADAPTATION.

the outer end of the fixture. If the wires conveying electricity are to be carried inside of the pipes composing the fixture it is desirable to substitute pipe crosses for the pipe tees. This will provide an open hole at each junction point through which access to the interior is given for pulling in the conductors. Keyless sockets with aluminum shells are commercially obtainable which are well adapted to out-of-door applications, such as those shown in Figs. 2 and 3.

A commercial out-of-door cluster is illustrated in Fig. 4 This type possesses the advantage of having a clear-glass dome which protects the lamps from dust. The dome is easily removed for cleaning without disturbing the tungsten lamps. The conductors feeding the cluster are carried inside of the wrought-iron pipe forming the arm. Two steadying chains are used, only one of which appears in the elevation shown. For 220-volt service the sockets can be wired in groups of two in series, permitting the use of 110-volt lamps.

Figs. 5 and 6 show adaptations of equipment, particularly designed for tungsten series street lighting to industrial-plant multiple conditions. Both equipments are commercial, but if desired for multiple service they should be so specified in the order. The outrigger unit (Fig. 5) can be furnished either

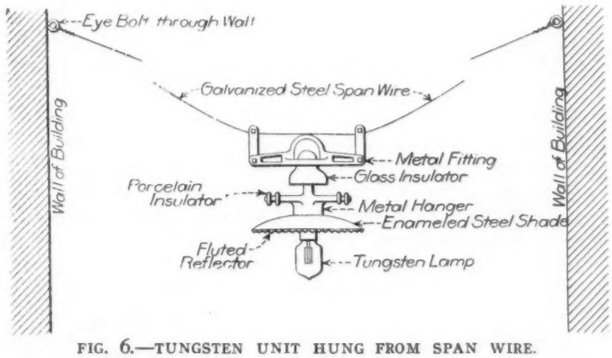


FIG. 6.—TUNGSTEN UNIT HUNG FROM SPAN WIRE.

with or without the fluted enameled steel reflector. Developments seem to indicate that the combination of fluted reflector and prismatic glass reflector gives best results for street and yard lighting conditions. For low-tension multiple work the massive iron-clad insulator between pipe-arm and fixture proper can be omitted. An arm, part of the fixture, has porcelain insulators mounted on each of its ends, on which wires supplying the lamp with energy can be terminated. A unit hung from a span wire strung between buildings is delineated in Fig. 6. The construction of this device is essentially like that just described (Fig. 5) except an arrangement is provided whereby the unit is clamped to the span wire. This combination should find many applications in industrial-plant practice for the lighting of areas between buildings and roadways. Obviously the span wire can be supported by a pole on either side of a roadway to meet the latter condition.

Multiple Tungsten Street Lighting for Grinnell, Iowa.

The City Council of Grinnell, Ia., recently voted to accept a proposition made by the Grinnell Electric & Heating Company to change the entire street-lighting system of the city from 6.6-amp alternating-current arc lamps to tungsten incandescent lamps. The city officials and citizens had been for some time dissatisfied with the system of street lighting in use. Mr. O. K. Cole, president and manager of the Grinnell Electric & Heating Company, instead of waiting for dissatisfaction with the system to gather strength, took steps in advance to offer the city as good a system of street lighting as the available appropriations would permit. Mr. J. R. Cravath was retained as consulting illuminating engineer to look over the existing situation, to decide upon the best system of street lighting available (bearing in mind the equipment which the company already had in place) and to formulate and present a proposition to the City Council on behalf of the company.

The present system of street lighting consists of a 6.6-amp alternating-current arc on every other corner, each arc being operated at constant potential from a small transformer located usually at the nearest alley. One side of the primary of each arc-lamp transformer is connected to the regular primary main, and the other side to a special street-lighting main which is controlled by a separate switch at the station. The multiple arc lamps are operated from standard-voltage transformers giving a secondary potential of 110 volts. The existence of this very peculiar system of street lighting had an important influence on the final decision as to the best scheme to adopt. The arc lamps were being operated on a moonlight 3 a. m. schedule at the rate of $65 per lamps per annum. There were also 11 incandescent lamps of 16 cp in use for street lighting.

At first some consideration was given to the possibility of retaining the existing arc lamps and filling in the dark spaces between with tungstens. It was soon evident, however, that this plan would call for a greater annual expenditure for street lighting than would be obtained from the city. The same objection held against another plan which was considered; that is, of moving all the arc lamps into the central part of town and spacing them one block apart instead of two blocks apart, as at present, placing tungstens in the outlying parts.

To replace the present arc lamps by some of the new luminous types recently placed on the market would have given a greater total amount of light, but would have involved a heavy investment cost in making the change, and would still leave the inherent defect of the present system, which is the difficulty of seeing a block away when facing an arc lamp when the surroundings are dark. Large lamps at such long intervals are blinding and extremely unsatisfactory.

It was finally decided that for all the residence portion of town the method of using an 80-cp tungsten lamp on each corner would give much better results than the present system, and at the same time would be within the reach of the city financially.

At first it was naturally assumed that the proper lamp to use would be the series tungsten lamp operated on a standard series street-lighting circuit with a constant-current transformer at the station. However, at the suggestion of Mr. Paul P. Meyers, superintendent of the company, estimates were also drawn up on a system using 110-volt multiple tungsten lamps operated from the small transformers at present used for the arc lamps. It was argued in favor of this system that it would

involve only a small initial investment to make the change to the new street-lighting system, and that the difficulties of maintaining lines would be much less than with a series system. The streets are lined with very heavy, rapidly growing shade trees, which flourish in the rich Iowa soil, and it is no small task to keep the street-lighting lines which run through these trees free from leaks and grounds. At present the 1100-volt primary lines are almost altogether in alleys which run north and south. The street-lighting transformers are located at the intersections of alleys with the east and west streets, so that there is only a half block of pole line in the street between the alley entrance and a street lamp. With this line from the alley to the street corner operated at 110 volts, much less trouble is experienced than with a high-tension line. Estimates were, therefore, made on both the series and the multiple tungsten system. It was found that the cost of changing to the multiple tungsten system would be about half that of changing to the series system. The reason for this difference was partly due to the fact that the transformers for the multiple system were already in use on the arc system, and the amount of new wire and poles was less with the multiple system because of the greater use which could be made of existing wires and poles.

Fig. 1 is a typical plan of two blocks showing the scheme to be employed for distribution on the multiple system. From

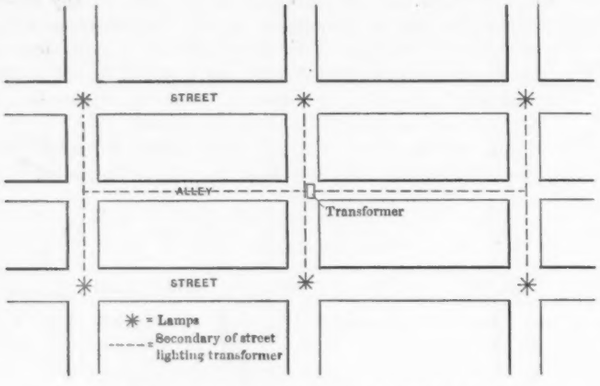


FIG. 1.—TYPICAL STREET-LIGHTING SECONDARY CIRCUIT.

this it is seen that one transformer of a sufficient rating to supply energy to one arc is adequate for six 100-watt tungsten lamps under the new system. This transformer is located centrally with regard to the six lamps which it supplies. One side of existing secondary circuits in alleys can be used as a return wire for the street-lamp circuit one block each way from each street-lighting transformer. This practically means that in two-thirds of the alleys there must be one additional secondary wire strung for street-lighting purposes. The third primary for the street-lighting transformers is already installed in most cases.

The tungsten multiple lamp is, of course, much more fragile than the series lamp, which point was given due consideration. However, since multiple tungsten lamps have been used in outdoor work where vibration and sudden shocks are more frequent than they would be in this case, it was thought that the other advantages of the multiple system would outweigh this possible disadvantage. The lamp sockets will be provided with a flexible support inside of the socket and reflector holder, so that shocks to the pole will be cushioned before they reach the lamp.

The present arc system supplemented with incandescents was costing the city $3,057 per annum. The rate offered by the company on a street-lighting contract providing for tungsten lamps was such as to provide an increase in gross revenue of $413 a year, at the same time providing street lighting for some outlying districts which have heretofore been practically without street lamps. In making this offer to the city it was necessary for the company to figure that most of the benefits to the company, as the result of this change, would be in the station equipment set free by the reduction in the maximum demand caused by street lighting. The financial returns to the comptany will, therefore, not be immediate, but will be spread out over a considerable period, whereas the advantages to the city will be immediate as soon as the improved and enlarged system is installed. While the rates per lamp are low considering the apparatus which must be thrown in the scrap heap, in deciding upon a price, the general principle was followed that it would be better to make it so low as to be beyond possible criticism than to attempt to make the new contract pay for the extra investment in a short period of time.

The proposition, as formulated and presented to the Council by the company's consulting engineer, was, in part, as follows:

"The present system of lighting is very inadequate, both in the central part of the town and in the outlying districts. In the central part of the town the long distance of two blocks between lamps makes a very dark space midway between lamps, which is made worse by shade trees and tree trunks. Large lamps at such long intervals are blinding, as all who have faced them at night know. In the outlying districts there are long intervals of several blocks in well settled territory in which there are no lamps.

"By virtue of some very important improvements in electric lamps which have come into practical use the past 18 months, it is possible for the company to offer you a system of street lighting which will not only cover a larger area than the present lighting, but will make an enormous improvement in lighting the entire city, for an amount but little greater than that now paid by the city for its street lighting.

"The system which is recommended consists of placing an 80 cp tungsten lamp on a bracket at each street intersection. In the central part of town around the business district and park several tungsten lamps of 48 cp each should be placed between street intersections as indicated on the map accompanying this report. The present arc lamp gives under actual service conditions about 200 cp at an angle which is effective for street lighting. The proposed system with an 80-cp tungsten lamp on each street intersection will give about 60 per cent more illumination midway between lamps than is now obtained with arc lamps on every other street intersection.

"It is recommended that these tungsten lamps be placed on brackets for several reasons: Brackets are neater in appearance than lamps suspended over the street. By using them it will be possible in some cases to place lamps in line with the tree trunks on one side of the street. This will result in less shading of the sidewalk by tree trunks on both sides of the street, a matter very serious with the present system. The use of the bracket also makes it possible to equip the lamp with a reflector which increases its useful candle-power for street lighting about 25 per cent. Such a large reflector as this cannot be used on a lamp suspended over the center of the street because of the effect of the wind on the reflector.

"The change to the new system will involve important changes in the company's entire street lighting system. The present arc lamps, which are only six years old, will have to be thrown out and at least half their value lost. However, on account of the greater economy of the tungsten lamp and the greater effectiveness of the smaller lamps placed on each corner as compared to the present arcs, the city can well afford to give the company a 10-year term of contract at a rate which will reimburse the company for throwing out the old apparatus.

"The following proposition is therefore submitted on behalf of the company:

"The Grinnell Electric & Heating Company will supply, light and maintain, for a period of 10 years, 122 tungsten lamps of 80 mean horizontal candle-power, each equipped with reflectors which will increase the candle-power at 5 degrees below horizontal to 100 candle-power, for the sum of $25 per lamp per annum.

"The Grinnel Electric & Heating Company will furnish, light and maintain, 21 tungsten lamps of 48 mean horizontal candle-power each, equipped with reflectors which will increase the candle-power 5 degrees below horizontal to 60 candle-power for the sum of $20 per lamp per year.

"These lamps will be lighted on what is commonly called "all night every night" schedule in which the lamps are to be lighted from dusk to dawn every night of the year.

"After a period of five years the cost is to be reduced to $20 a year for the 80-cp lamps and $15 a year for the 48-cp lamps.

"It is to be understood that the rated candle-power stated in this proposition is to be the candle-power of the lamps when

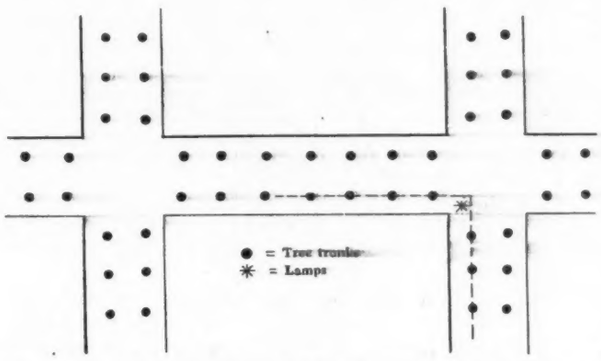


FIG. 2.—LOCATION OF LAMPS TO LESSEN TREE-TRUNK SHADING OF SIDEWALKS.

new and that 20 per cent depreciation from foregoing figures is to be allowed."

The plan suggested will cost the city per year for the first five years as follows:

122 lamps of 80 cp at $25 a year	$3,050.00
21 lamps of 48 cp at $20 a year	420.00
Total	$3,470.00

Fig. 2 illustrates the arrangement recommended in the proposition regarding the location of lamps to avoid the shading of sidewalks by large tree trunks. The trees are so large and numerous on many of the streets that arc lamps 900 ft. apart in the center of the street, as on some streets, throw very little light on the sidewalks. Soon after the presentation of the company's proposition to the City's Council, a sample installation of 100-watt tungsten lamps was put up and the advantages of the new system were apparent. The proposition was accepted.

New Telephone Patents.

NEW APPARATUS.

A new design of desk set has been invented by Mr. J. A. Birsfield, of Chicago, Ill., he having assigned his patent to Mr. Alfred Stromberg. One feature is the transmitter clamp. The head of the stand is a hollow sphere, cut at an angle into two parts which screw together. A plate with a central perforation crosses at the joint, and the movable part of the head swings about a lug which it carries and which projects into the hole in the plate. The body of the movable head is held with the inside of the hollow sphere, a leather friction washer being interposed.

The hook switch lever is also novel, being carried by a small cylinder which will drop into place in notches and be clamped by the head piece. The lever is thus readily removable. The springs are in the base of the stand, a push rod connecting the lever with them.

Mr. J. M. Haff, of Los Angeles, Cal., has patented an antiseptic device for transmitter mouthpieces. This is a funnel-shaped metal device carrying an antiseptic diaphragm. Its edge is turned back, forming a threaded flange upon which, from the rear, a clamp ring is screwed. This arrangement holds the device firmly in place.

An adjustable mounting for transmitters has been invented by Mr. A. G. Kaufman, of New York City, the American Callaphone Company having obtained the patent by assignment. The apparatus provides for a considerable vertical movement of the instrument and for cushioning it against jar.

LETTER TO THE EDITOR.

Polyphase Magnetomotive Forces.

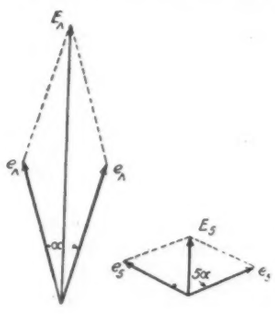
To the Editors of Electrical World:

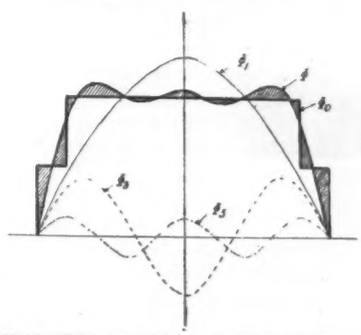
SIRS:—In connection with the article by Mr. J. D. Nies entitled "Polyphase Magnetomotive Forces," which appeared in your issue for Aug. 26, the following remarks may not be out of order.

In the article referred to occurs the statement that in polyphase windings there are combined several m.m.fs., thereby developing a resultant m.m.f. which is in motion with respect to the coils that produce it. It would be more nearly correct to state that in polyphase windings there is produced a m.m.f. of approximately constant intensity, the direction of which revolves synchronously with approximately constant velocity.

In this article are also the statements that in the irregular step curve of m.m.f. in any polyphase apparatus there is a constant fundamental component rotating at constant synchronous speed and various harmonics, each of which is constant in value and rotates at a constant speed equal to 1/m th of the synchronous speed, and that in three-phase machines the third harmonic and all multiples vanish. Now it should be borne in mind that the harmonic components of any distorted wave are merely mathematical fictions and have no indepenpent physical existence. The amplitudes of the fictitious components of a distorted flux wave are constant in value only in the case of an ideal motor, and in an actual motor the amplitudes vary somewhat from instant to instant.

Under the heading "Counter Electromotive Forces" is the statement that the counter e.m.fs. due to the harmonics are all





FIGS. 1 AND 2.—DIAGRAMS ILLUSTRATING METHOD OF CALCULATING E.M.F. FIG. 3.—DISTORTED FLUX WAVE.

of the same sign and add directly to the counter e.m.f. due to the fundamental. A slight modification of this statement may not be out of place. The e.m.f. induced in the wires embedded in one slot by the pulsating or revolving flux of magnetism, the instantaneous values of which do not follow the sine law may be found as follows:

Denoting by e the instantaneous values of any distorted e.m.f. wave its effective value E is found from the equation:

$$E = \sqrt{\frac{1}{T}\int_0^T e^2 dt} \qquad (1)$$

Now $e = \Sigma E_x \sin x\,\omega t$, where E = amplitude of any harmonic component, x the order of the component under consideration. ω = angular velocity, t = time.

Transposing equation (1),

We obtain $$E = \sqrt{\Sigma E_x^2} \qquad (2)$$

Hence, if E_1, E_3, E_5, E_7 are the effective values of the harmonic components as calculated from their respective fluxes there is obtained for the effective value of the e.m.f. induced by the distorted flux wave:

$$E = \sqrt{E_1^2 + E_3^2 + E_5^2 + E_7^2}, \qquad (3)$$

since the wave of magnetism is symmetrical with respect to the 90-deg. ordinate.

When calculating the e.m.f. induced by a distorted flux wave

in the coils of a distributed winding, the following method must be resorted to, if accurate results are to be obtained:

Suppose the machine under consideration is a three-phase motor with two slots per pole per phase. Let the flux wave contain comparatively prominent fifth and seventh harmonics. Let e_1, e_5, e_7 denote the effective values of the fictitious components of e.m.f. induced in the wires of one coil. The total e.m.f. induced per pole per phase is now found as indicated below. With six slots per pole the angular displacement α between slots in electrical space-degrees equals $\alpha = \frac{180}{6} = 30$ deg.

First consider the fundamental (Fig. 1):

$$E_1 = 2\,e_1 \cos\frac{\alpha}{2} = 2\,e_1 \cos 15 \text{ deg.} = 1.9318 e_1.$$

Considering that the electrical displacement for the fifth and seventh harmonic equals 5α and 7α, respectively, we obtain (Fig. 2):

$$E_5 = 2\,e_5 \cos 5\frac{\alpha}{2} = 2\,e_5 \cos 75 \text{ deg.} = 0.5176\, e_5.$$

$$E_7 = 2\,e_7 \cos 7\frac{\alpha}{2} = 2\,e_5 \cos 105 \text{ deg.} = -0.5176\, e_5.$$

Hence, the effective value of induced e.m.f. per pole per phase is found to be from equation (3):

$$E = \sqrt{(1.9318\,e_1)^2 + (0.5176\,e_5)^2 + (0.5175\,e_7)^2} \qquad (4)$$

If the individual distribution factors of the higher harmonics are not taken into account there is obtained:

$$E = 1.9318\sqrt{e_1^2 + e_5^2 + e_7^2} \qquad (5)$$

The difference between the values of E as obtained from equations (4) or (5) may be considerable.

Secondary Currents.

The fact that an induction motor may run against its own field as observed by Mr. O. S. More has been explained by Mr. Nies to be due to the presence of higher harmonics.

In the following an attempt is made to illustrate the effect of a distortion of wave shape upon the performance of an induction motor:

Assume that the distribution of the field in the air-gap of an induction motor does not follow the sine law, but contains a pronounced triple and a less prominent quintuple harmonic. Fig. 3 may represent such a curve.

As seen from the diagram Φ_1 Φ_3 Φ_5 represent the fictitious harmonic flux components of the first, third and fifth order respectively. The curve drawn in heavy full line marked Φ is the resultant of Φ_1 Φ_3 Φ_5, the equation of which may be written:

$$Y = \Phi_1 \sin \omega t + \Phi_3 \sin 3\omega t + \Phi_5 \sin 5\omega t$$

or, if there be assigned to the amplitudes of Φ_3 and Φ_5 the values 0.3 Φ_1 and 0.1 Φ_1 respectively, one may write:

$$Y = \Phi_1 (\sin \omega t + 0.3 \sin 3\omega t + 0.1 \sin 5\omega t)$$

The step curve Φ, such as may be obtained in a two-phase motor with two slots per pole per phase deviates somewhat from curve Φ_0. The shaded portions embraced by the curves Φ and Φ_0, which may be called "the remainder," are due to harmonics of order higher than five. The latter may well be ignored, as their influence upon the performance of the motor is negligible.

Imagine that the three fluxes Φ_1 Φ_3 Φ_5 are produced by three separate stator windings, w_1 w_3 w_5, which are arranged in such a manner along the circumference of the stator as to produce a sinusoidal distribution of the respective fields in the air-gap.

Let w_1 produce "p" poles, w_3 = "$3p$," w_5 = "$5p$" poles, the number of turns being so chosen as to result in the field densities assumed above.

If, now, the coils w_1 w_3 w_5 are in turn excited by three harmonic currents of "N" alternations per minute, the rotor will revolve with $\frac{N}{p}$, $\frac{N}{3p}$, $\frac{N}{5p}$ revolutions per minute, respectively.

Suppose the coils are connected in parallel and excited simultaneously by three harmonic e.m.f. of a three-phase system. One might then say that each of the three separate windings produces its own field, each of which fields induces an e.m.f. in the rotor. Going still a step further, one might say that the arrangement represents three (imaginary) motors, I, III, V, in one frame, each with separate stator and rotor windings.

The reader is now referred to Figs. 4 and 5, which represent the torque curves of an induction motor plotted as a function of the slip. The curves are intended to illustrate the effects of Φ_3 and Φ_5 upon the performance of the machine.

Assume first that the distribution of the field in the air-gap is sinusoidal, as shown by the curve Φ_1, Fig. 3; in other words,

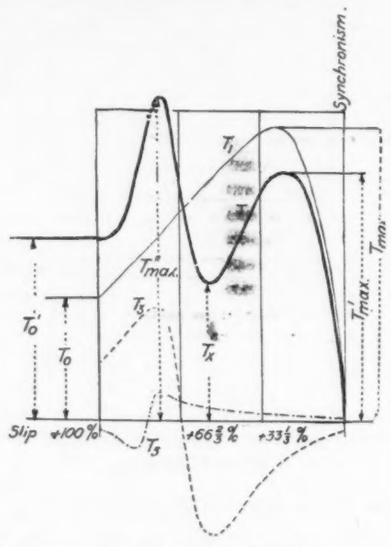


FIG. 4.—DIAGRAM OF TORQUE DEVELOPED BY HIGH-RESISTANCE ROTOR.

only motor I is in circuit. The curves T_1, in Figs. 4 and 5, show the torque developed by motor I as a function of the slip; Fig. 4 for a high resistance, Fig. 5 for a low-resistance rotor. These curves are familiar to the electrical engineer and require no further explanation.

If, now, windings w_3 and w_5 are also excited, the torque is

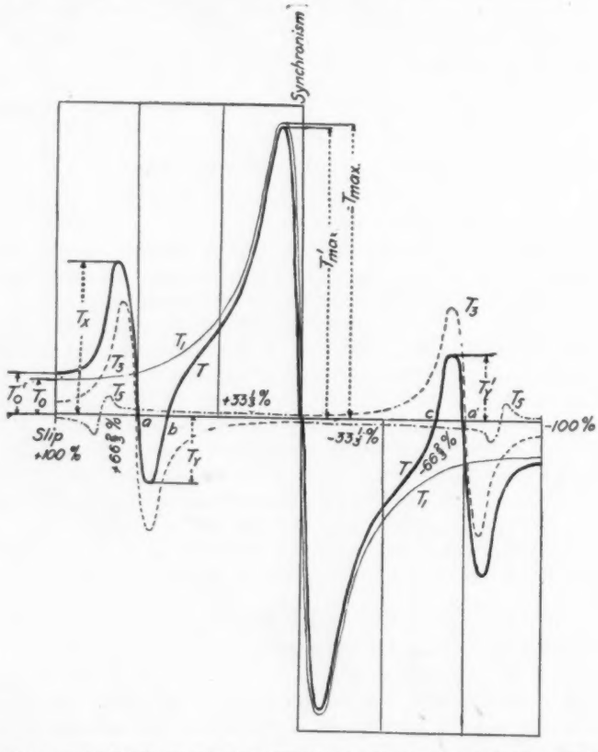


FIG. 5.—DIAGRAM OF TORQUE DEVELOPED BY LOW-RESISTANCE ROTOR.

no longer represented by the curve T_1. In addition to the latter there are to be considered the curves T_3 and T_5 representing the torques of fictitious motors III and V respectively.

Returning to the real motor, the distorted flux curve (step

curve) Φ_0 will give rise to the irregular torque curve T shown in heavy full lines in Figs. 4 and 5.

A brief study of the diagrams reveals the following facts:

In the absence of higher harmonics, the high-resistance motor will start with a torque T_0 and will attain its maximum torque T_{max} about 20 per cent below synchronism. Due to the field distortion there will result a torque curve which affects the performance of the motor in the following manner:

The starting torque is increased from T_0 to T_0'; the maximum torque T''_{max} is attained at a slip of about 70 per cent; and the torque T'_{max} developed at a slip corresponding to T_{max} reduces the pulling-out torque of the motor near synchronism considerably.

If at a slip of about 50 per cent the torque demanded by the load exceeds the value "T_x" the motor will fall out of step.

If, now, the high resistance rotor be replaced by one the resistance of which is low, the effect of the field distortion becomes much more marked.

An inspection of Fig. 5 shows that the increase in starting torque due to the higher harmonics is only slight; the effect of Φ_3 and Φ_5 upon the maximum torque near synchronism is negligible; at a slip of $+20$ per cent the torque has risen to a value T_x much in excess of the starting torque, due chiefly to the fictitious motor III, and at a slip of about $+65$ per cent the torque has become zero while at a slip of 60 per cent it reaches the negative value T_y.

Such a motor cannot accelerate to synchronism, even without load, because the torque between the points "a" and "b" is negative.

From the above facts can be explained the phenomena that a two-phase motor might run against its field. Suppose the motor of Fig. 5 is running at synchronous speed in a clockwise direction; and let the leads to one phase be reversed. The field will then revolve counter clockwise; the rotor speed will decrease and attempt to follow the field—that is, to reverse.

The rotor is now revolving with a negative slip, the torque being positive—that is, in the direction of the rovolving field.

As soon as the speed has dropped to a value indicated by point "c" at a slip of about -55 per cent, a further drop in speed will cause the motor to develop a negative torque—that is, a turning moment against the field which reaches a maximum in T_y' at a slip of about -60 per cent. At this value the motor speed remains, provided the torque demanded by the losses and load does not exceed the value T_y'. A slight further drop in speed causes the torque to go through zero at point "d" and the motor will reverse its direction of rotation.

It is seen, therefore, that primarily the effect of the third harmonic, as pointed out by Mr. Nies, is responsible for the phenomenon. However, it is not true that the third harmonic at a slip of 133 per cent becomes a "forward one." As seen from Fig. 5 the effect of Φ_3 at $S = -33$ is negligible.

Mr. Nies advocates the employment of fractional-pitch windings for the purpose of suppressing the higher harmonics in the flux wave of induction motors. As first pointed out by Professor Adams, a fractional-pitch winding, as compared with a full-pitch winding, embodies the advantageous features of reducing the reactance of the motor winding and decreasing the over-all length of the motor. On the other hand, with a fractional-pitch winding, the cross-connections are more complicated and the difficulty of insulation of slots and between coils (high-pressure machines) becomes more pronounced because certain slots contain conductors belonging to different phases.

Considering that in two-phase motors with a few slots per pole per phase the distribution of the field in the gap produced by a full-pitch winding deviates considerably from the sine form, the employment of fractional-pitch windings for such motors should prove advantageous. However, in the case of three-phase motors, where the amplitudes of the higher harmonics are only a few per cent of that of the fundamental wave, it would seem that the choice between full-pitch and fractional-pitch winding will vary according to the case under consideration.

CHICAGO, ILL. HENRY HERMANN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Speed Control of Induction Motors.—H. C. SPECHT.—In a continuation of former articles on the speed control of induction motors, the author now discusses the use of frequency changers. The methods used are based on either of two general principles. By the first principle speed variation is obtained by changing the primary frequency applied to the driving motor and operating it as an ordinary induction motor. The second principle is that of connecting the primary winding of the driving motor to the constant-frequency supply circuit, speed control being obtained by impressing different frequencies upon the secondary winding of the driving motor. An example of the first principle is represented by the arrangement of induction motor and frequency changer set shown in Fig. 1, A being a

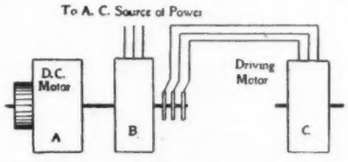


FIG. 1.—SPEED CONTROL OF INDUCTION MOTORS.

direct-current motor and B an induction motor. The primary of the induction motor B is connected to the alternating-current line and the speed of the set is controlled by the direct-current motor A. The secondary of this motor B furnishes the energy to the motor which is to be run at variable speeds. Another method of changing the frequency is by means of an arrangement similar to that just described except that the motor B is operated as an induction generator. For the foregoing methods of changing frequency (or speed), sufficient direct-current energy is required to make up for the change in frequency. As a rule, however, alternating current and direct current are not both available. As a third method of obtaining variable speed by change of frequency, the scheme shown diagrammatically in

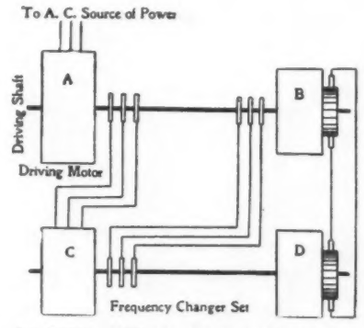


FIG. 2.—SPEED CONTROL OF INDUCTION MOTORS.

Fig. 2 may be more practicable. The primary of the induction motor A is connected to the alternating-current supply circuit and its secondary is connected to the primary of another induction motor C, the latter also being a wound-rotor type of machine, mounted on a separate shaft. The secondary of motor C is connected with the armature winding of a rotary conver-

ter *B* mounted on a common shaft with the driving motor *A*. The commutator of *B* is in circuit with the armature of another machine *D*, which is mounted on the same shaft as machine *C*. This latter machine acts as a frequency changer and its speed is governed by that of the direct-current machine *D*, which is given a certain excitation by a shunt-field circuit or by a compound shunt and series-field circuit, depending on the kind of speed regulation which is desired. The machines *D* and *B* may be self-excited or separately excited. For a certain speed of the set *C-D*, and with the connection between the commutators of *B* and *D* closed, the driving, or power, set *A-B* will have a definite speed. The regulation of speed is accomplished entirely by regulation of the field current of the machine *D*, a single adjustment being required for a given speed, without regard to the load. In an editorial by B. G. Lamme some general principles of changing the speed of induction motors are discussed, and a comparison is given between the alternating-current induction motor and the direct-current shunt motor as regards speed adjustment and regulation—*Electric Journal*, October.

Rectifier.—A description of a new rectifier made by a British manufacturer for converting alternating current to direct current, especially for small outputs, for charging storage batteries, etc. Its method of operation is based on the fact that if two secondaries of a transformer are alternately put into circuit at each half period, the induced current feeding the secondary circuit will be unidirectional. The apparatus consists of two parts: (1) A transformer wound with two secondaries in series or an auto-transformer with a middle point which acts as

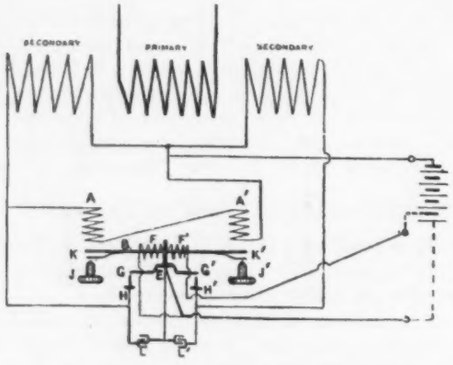


FIG. 3.—DIAGRAM OF RECTIFIER CIRCUITS.

a phase divider; and (2) the rectifier. In Fig. 3 *A*, *A'* are two small field magnets and *B* an oscillating armature pivoted at the center; the armature is wound with two coils *F*, *F'* and excited by direct current, taken from one of the cells to be charged; the current consumption of this is insignificant, being only 0.4 amp. If the apparatus is used for a purpose other than charging accumulators, a small cell is provided for this excitation. The two magnets *A*, *A'* are fed from one of the secondaries, and wound so as to have similar poles facing both ends of the armature. The latter carries a contact piece *E*, which, as the armature oscillates, makes contact alternately at *H*, *H'*. Two springs *K*, *K'*, bearing on two regulating screws *J*, *J'*, are provided for tuning up the apparatus. The two small condensers *L*, *L'* overcome any tendency to sparking at the contacts, although as the make-and-break takes place at zero current there is normally no tendency to spark. In operation, as the armature excitation is by no means of direct current, and fixed opposite polarities exist at either end, the armature receives an oscillating motion corresponding to the rapid change in polarity of the magnets *A*, *A'*, due to their alternating-current excitation; this oscillation alternately produces contact between *G*, *H* and *G'*, *H'*, cutting in and out first one transformer secondary and then the other, the induced currents feeding the outgoing circuit being always in the same direction. The field magnet excitation requires about 4 watts.—Lond. *Elec. Review*, Sept. 3.

Single-Phase Commutator Motors.—J. Fischer-Hinnen.—A translation of his recent German paper on the calculation of single-phase motors from the practical standpoint.—Lond. *Electrician*, Sept. 24.

Operation of Alternators in Parallel.—K. Edgcumbe and A. H. Ellis criticise various points in the recent article of J. W. Anson, to which the latter replies.—Lond. *Electrician*, Sept. 17 and 24.

Lamps and Lighting.

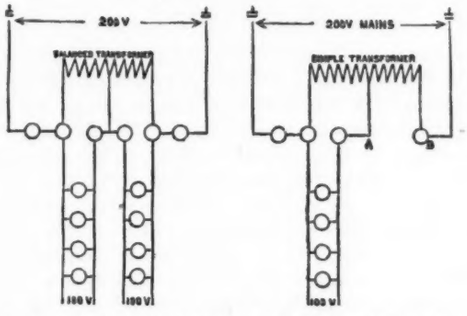
Tungsten Filament.—A. C. Jolley.—A communication on Steinmetz's recent article on the power characteristics of the tungsten filament. His experimental results are confirmed by the observations of the present writer, which are expressed by the equation $W = 0.0372\,V^{1.55}$. But, although as Steinmetz points out, it is possible to predict the 1.6th power of the voltage by assuming that the lamp is radiating according to the Stefan law, and that its resistance changes in direct proportion to the absolute temperature, it is, unfortunately, very probable that these two conditions do not hold for metallic-filament lamps, for most observers now agree that the radiation from these lamps is highly selective, and, therefore, does not follow the fourth-power law; moreover, owing to the accidental presence of impurity from the processes of manufacture, the tungsten filament seldom gives a temperature-resistance curve which would pass through the absolute zero. On the other hand, tantalum, which is produced in a high state of purity and mounted in the lamps as a wire, gives the required temperature-resistance curve. If the power consumption be plotted against voltage for such a lamp the relation $W = 0.0167\,V^{1.7}$ is obtained. It would, therefore, seem that the remarkable agreement between theory and experiment in the case of the tungsten filament must be regarded as a coincidence and is not of universal application.—Lond. *Electrician*, Sept. 24.

Tungsten Filament.—A note on a recent British patent of the Siemens & Halske Company (17,611, 1908; Sept. 16, 1909). Tungsten alloyed with from 8 per cent to 10 per cent of nickel is more ductile than pure tungsten, and can be drawn into filaments. According to this invention, the formation of the alloy is hastened by the addition of from 0.5 per cent to 1 per cent of iron, cobalt or copper.—Lond. *Elec. Eng'ing*, Sept. 23.

Cadmium Arc.—T. M. Lowry.—A paper read before the British association. In order to produce a cadmium spectrum of sufficient intensity for polarimetric work, advantage is taken of the favorable properties of the silver-cadmium alloys. On account of their isomorphism the two metals form an excellent series of alloys which are characterized by good mechanical properties and very high melting points. An alloy with 60 per cent Cd melts at a temperature as high as 700 deg. C. In striking contrast to the behavior of the pure metal, the alloy gives a steady arc which can be kept true to the center by rotating the electrodes in the opposite direction. The spectrum shows the silver as well as the cadmium lines, but these are so far separated that even with a low resolving power the slit of a spectroscope can be opened to its full width without any overlapping of the brilliant "blocks" of light which take the place of the usual "lines."—Lond. *Elec. Review*, Sept. 3.

Transformers for Metallic-Filament Lamps.—L. Crough.—The first part of an article on small transformers of from ¼ kw to 5 kw for metallic-filament lamps. Their manufacture has developed into a large industry during the past few years. The author describes and illustrates several types of construction. There are two vitally different arrangements of the secondary circuit; the difference is apparently slight (see Figs. 4 and 5), consisting in the omission of a second low-tension circuit across the points *AB* in Fig. 5. This difference, however, has a great effect on the rating of the transformer, since the utilization of the second low-tension circuit increases the total load that can be safely dealt with by the set by at least 600 per cent. The transformer is said to be of the "balanced" type if connected as in Fig. 4, and of the "simple" type if connected as in Fig. 5. For high efficiency and low cost of installation the "balanced" is far superior to the "simple" auto-transformer, since the maximum losses are only those due to the full load of the trans-

former when the total load supplied is six or seven times the latter. The cost of installation is also only that of a transformer capable of dealing with the out-of-balance current. The efficiency of a "balanced" auto-transformer may be kept well above 99 per cent, whereas that of a "simple" set rarely exceeds 98 per cent. It is difficult to obtain a high efficiency in simple transformers. Thus, the efficiency of a 200-watt eight-to-one transformer is not more than 93 per cent or 94 per cent. It



FIGS. 4 AND 5.—DIAGRAM OF SECONDARY CIRCUITS.

is usually advisable to secure maximum efficiency at about three-fourths full load, the efficiency at half and full load being less by about 0.5 per cent. The article is to be continued.—Lond. *Elec, Review,* Sept. 3. In the second part of his article the author discusses, with the aid of diagrams, the no-load losses and the cost of auto-transformers, and finally gives a numerical example of the economies attending the use of metallic-filament lamps and auto-transformers.—Lond. *Elec. Review,* Sept. 10.

Generation, Transmission and Distribution.

New Steam Turbines.—At Lot's Road generating station of the Underground Electric Railways Company, in London, eight old steam turbines, each rated at 6000 kw, which have been running since 1904, are being replaced by new turbines of the Parsons type. When the eight existing turbines are replaced by the six new ones, which will be more than sufficient for the load, the coal bill will be reduced by at least one-third, and it is estimated that a yearly saving of $150,000 will result, since at present some 500 tons are used daily. Moreover, it has previously always been found necessary to run the entire battery of eight boilers forming the complete unit for each turbine, which, therefore, was unable to develop its full power when one or more of the boilers was shut down for cleaning or repairs. With the lower steam consumption of the Parsons machines, only five boilers out of the eight are required for normal load, and it is hoped to keep them in better condition.—Lond. *Electrician,* Sept. 24.

Electric Power for Shipbuilding Plant.—An illustrated description of the uses of electric power in the works of Armstrong, Whitworth & Company, in Manchester.—Lond. *Elec. Review,* Sept. 10 and 17.

Steam Condensers.—F. Hodgkinson.—In a continuation of his illustrated serial on the choice of a steam condenser he discusses jet condensers and entrainers.—*Electrical Journal,* October.

Traction.

Electric Traction in Great Britain.—A. L. C. Fell.—His presidential address to the (British) Municipal Tramways Association. He first gives statistical data on electrical traction in Great Britain. There are 305 undertakings in the United Kingdom, 177 of which belong to municipalities and 128 to companies and private individuals. The tramways open consist of 1522 miles of double and 941 miles of single line, or a total of 2463 miles, compared with 2394 miles in the previous year. The total capital expended was $340,999,590, compared with $320,460,455 in the previous year. The total number of passengers carried was 2,625,532,895, compared with 2,454,807,487. The gross receipts were $62,198,125, compared with $59,245,875. The working expenses were $38,963,315, compared with $36,818,810 in the previous year. He then discusses the advisability of the revision of the British tramway act of 1870. He deals with "the best use of the thoroughfare," emphasizing that the installation of a tramway does not generally increase the congestion in a street. He refers to railless trolley systems, which may be of use in some special cases. He then emphasizes the necessity for standardization of plant, cars and equipment. He ridicules the use of the "car-mile" as a basis of comparison between different systems. The article is to be concluded.—Lond. *Electrician,* Sept. 24.

Energy Consumption on Tramways.—R. S. Pilcher.—A paper read before the (British) Municipal Tramways Association. The author believes that the remedy for preventing the increase in energy consumption per car-mile on tramways is improved methods of operation. He shows the effect at Aberdeen of explaining to the motormen the saving to be obtained by careful driving, following this up by the installation of meters on the cars. On the Aberdeen tramways he uses amp-hour meters, and these meters have already paid for themselves by the reduction in energy consumption. The author thinks that any system of electric tramways which has no method of checking energy consumption will use at least 5 per cent more energy per car-mile than a system which has a systematic check on the motormen. In Aberdeen, simultaneously with the introduction of systematic supervision of the motormen, he noticed a great improvement in the timekeeping of cars; also, which is very important, a great reduction in motor troubles, the number of armatures in for repairs being greatly decreased.—Lond. *Electrician,* Sept. 24.

Electric Tramways in the West.—Long detailed and profusely illustrated descriptions of the Denver street tramway system, interurban roads in Colorado, electric railways in Utah, electric railways in and about Spokane, in the Puget Sound district, in Oregon and Los Angeles. Also an account of historical interurban electric railways and a history of the past half-decade.—*Elec. Railway Journal,* Oct. 2. (Denver Convention Section.)

Installations, Systems and Appliances.

Earthing the Neutral of Three-Wire Systems.—A discussion illustrated by diagrams. The Board of Trade regulations in England are that the middle wire of every three-wire system shall be earthed at the generating station and efficiently insulated over the rest of its length. Either such earthing, or complete earthing, over the whole length of the main is necessary. If the earth at the generating station be through an appreciable resistance as is advisable for this earth connection to be the only one on the main, which should be carefully insulated at all other points. If, however, a very low-resistance earth connection be preferred, then the main should be earthed throughout its length, a number of local earth connections being undesirable. The author shows finally how to carry out calculations regarding neutral earth conductors.—Lond. *Elec. Review,* Sept. 10.

Controller for Elevators.—An illustrated description of an elevator control gear made by a British company. The controller itself is built up in skeleton form without the use of marble or slate panels, the whole of the apparatus being, in fact, carried on a metal framework, which is insulated where necessary with micanite. This type of construction, it is claimed, eliminates the possibility of the controller being crippled by the breakage of a panel, and at the same time allows the whole arrangement to be easily adjusted or cleaned. Various details of the construction are described and illustrated.—Lond. *Electrician,* Sept. 24.

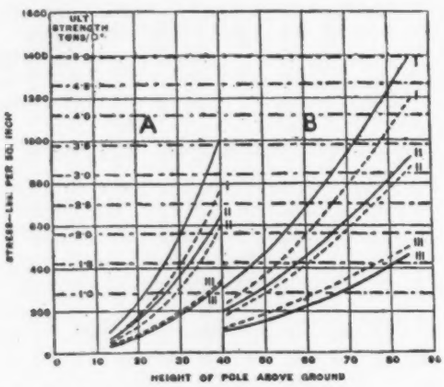
Repair Shop.—W. E. Ireland.—A paper read before the (British) Municipal Tramways Association. A description is given of the various shops comprising the repair depot of the London County Council Tramways. Details of the equipment of each shop, and the method of dealing with the repair and overhauling of cars, are given, together with interesting information with regard to the life of wheel tires, pinions, etc.—Lond. *Electrician,* Sept. 24.

Wires, Wiring and Conduits.

Pole Testing.—S. M. Powell.—The deflection of a simple cantilever, loaded either by a uniformly distributed or by one or more concentrated loads, theoretically varies in direct proportion to the total load, the equations applicable to the two cases being, respectively,

$$\delta = \tfrac{1}{8}\frac{Wl^3}{EI} \qquad \text{and} \qquad \delta = \tfrac{1}{3}\frac{Wl^3}{EI}$$

where δ = deflection, W = total load, l = length of cantilever or "arm" of load in the two cases, E = Youngs's modulus, I = moment of inertia of section of cantilever. The formulæ are very closely satisfied by ordinary single telegraph or telephone poles; the former is used in making calculations relevant to wind pressure, and the latter when estimating the effect of wind pressure on the lines, this being transmitted to the pole as a concentrated load by the cross-arms. Where A-shaped poles are used the deflection for a given load applied transversely to the length of the line is naturally much less than in the case of single poles (the ration varying from 1/30 to 1/60, and being usually about 1/50). Moreover, the deflection no longer varies directly with the load, but, roughly, in accordance with a law, $\delta = KL^n$, where δ = deflection, K = constant, L = load, and n = a numerical index constant for each particular case and usually lying between 1 and 2. The author then gives details of the construction of A-shaped poles, with notes on the liability to slip at the top joint. The stress on the poles at the ground level, and 5 ft. above the latter (these being standard points of reference in pole calculations), due to a wind pressure of 30 lb. per square foot (this being taken as the maximum force of the severest gale likely to be encountered on ordinary systems), are shown in Fig. 6. These results allow for the taper of the poles



A = 10-in. poles. B = 20-in. poles.
Full lines = stress due to B.M. at ground.
Dotted lines = stress due to B.M. 5 ft. above ground.
Case I = Parallel poles. Case II = Top dia. only half ground dia. Case III = Tapered to point.

FIG. 6.—POLE TESTS.

(about 1 in 120), and assume a cylindrical surface to have a coefficient of resistance equal to one-half of that of an equal plane surface. The curves refer to a considerable range of lengths and assume a uniform ground diameter of, say, 10 in., for poles up to 40 ft. long, and, say, 20 in., for poles 85 ft. long (these lengths being the projection above the ground; from 5 ft. to 9 ft. have to be buried according to the size of the pole). —Lond. *Elec. Review,* Sept. 3.

Calculation of Transmission Lines.—A. Blondel and C. LeRoy.—In the calculation of high-tension transmission lines it is necessary to take into consideration the capacity and leakage which are uniformly distributed along the line. In the past this problem has been solved mainly by means of graphical constructions, with the aid of hyperbolic functions. In the present article the authors begin to describe a simple method which is suitable for practical use and which does not necessitate the use of hyperbolic methods and complicated calculations. The article is to be continued.—*La Lumière Elec.,* Sept. 19.

Compound Conductors.—A note on a recent British patent of R. K. Gray (17,283, 1908; Sept. 9, 1909). In a conductor composed of a central solid or stranded core of one metal surrounded by a wire or tape sheath of another metal, the wires or tape of the sheath are given a coating of the same metal as that at the surface of the inner core. The object is to prevent corrosion due to moisture. If more convenient, both the core and the sheath wires may be given a surface coating of the same metal.—Lond. *Elec. Eng'ing,* Sept. 16.

Electrophysics and Magnetism.

Radio-Activity.—O. Hahn.—A British Association paper on the separation of new radio-active disintegration products. The author and L. Heitner have formerly proposed, as a working hypothesis, that single radio-active products emit only one type of radiation, either homogeneous alpha particles or homogeneous beta particles. This hypothesis has been found useful. An interesting deduction now made is that radium itself must be complex and consist of two different products, say, radium and radium x. "If further work should prove radium to be complex, there is little doubt that the few other radio-active transformation products which still emit complex rays are complex, and, therefore, to be separated. We might then be in a position to find some relation between the life period and other qualities of the products and the kind and velocity of the rays the particles emit."—Lond. *Electrician,* Sept. 17.

Luminous Discharges in Gases.—R. F. Earhart.—An abstract of a British Association paper on the effect of temperature variations on the luminous discharge in gases at low temperatures. The apparatus used in this investigation consisted of a small glass bulb in which two parallel electrodes were sealed. These electrodes were 5 mm apart. Suitable tubes permitted the bulb to be evacuated, the pressures being measured with a Macleod gage. The bulb was contained in an electric furnace, which could be used also as a container for carbon-dioxide snow, when measurements were taken of discharges occurring at low temperatures. Potentials required to produce a luminous discharge for pressure varying from 78 deg. C. to 325 deg. C. were observed. The gases operated upon were air, hydrogen and carbon dioxide. Potentials required to maintain the luminous discharge under similar conditions were also measured. Families of curves showing the effects of temperature and pressure for potentials both to produce and to maintain luminous discharge are given. They indicate that Paschen's law holds approximately for the discharge in air until temperatures in the neighborhood of 300 deg. C. are attained. Here Paschen's law does not hold even approximately. The effect of temperature variation on the potential required to maintain the discharge is much less than for the production of the initial discharge.—Lond. *Electrician,* Sept. 17.

Conductivity of Flames and Magnetism.—H. A. Wilson.—An illustrated paper read before the Royal Society in London on the effect of a magnetic field on the electric conductivity of a flame. The author gives an account of some measurements of the change in the conductivity of a Bunsen flame produced by a magnetic field, the direction of which is perpendicular to the current through the flame and to the motion of the flame gases. The velocity of the negative ions in the flame is calculated from the results, and the value of the velocity obtained agrees approximately with that found by other methods.—Lond. *Electrician,* Sept. 24.

Determination of Resistances by Graphics.—F. W. Harris.—An article illustrated by diagrams showing a simple method by which the complex calculations required in determining resistances for motor control equipments to give certain conditions of acceleration are made with ease and clearness by graphic solution. The graphical determinations of both resistances in series and resistances in parallel are discussed.—*Electric Journal,* October.

Electrochemistry and Batteries.

Nitric Acid from Air.—F. Russ.—An illustrated description of the Innsbruck plant for obtaining nitric acid from air. Use

is made of the Pauling process, in which arcs are produced between two electrodes which are curved like the electrodes of a horn lightning arrester. The two horns are nearest together at the bottom, and the arc is lighted at that point. On account of the rising hot air the arc rises upward, becomes longer and is broken once for every half period of the alternating current. A new arc is then lighted at the bottom, and so on. At present 24 furnaces are in operation at the Innsbruck plant, with an aggregate rating of 15,000 hp. Sixty grams of HNO_3 are produced per kw-hour in the Paulding process.—*Electrochem. and Met. Industry,* October.

Electric Iron and Steel Industry in Sweden.—E. HAANEL.—An account of his official report on his visit to Donnarfvet, in Sweden, where he investigated the Grönwall-Lindblad-Stalhane electric furnace for iron-ore reduction. He also describes a new electric steel furnace of the same inventors. It is operated by two-phase currents. The terminals of one pole of the two phases are electrically connected with one of the two adjustable electrodes of the furnace (suspended vertically through the top), while the terminals of the other poles of the two phases are electrically connected with the lining to the furnace. This lining is made of magnesite or dolomite. It is a "conductor of the second class" and is a non-conductor at ordinary temperatures. When the furnace is to be started, coke is placed on the lining and the lining is thus preheated and then becomes a conductor. The furnace is intended for continuous operation.—*Electrochem. and Met. Industry,* October.

Calcium Carbide.—C. A. HANSEN.—A paper read before the International Congress of Applied Chemistry on an investigation in which the author studied the reaction $CaO + 3C = CO + CaC_2$, with particular reference to the equilibrium CO pressure at various comparatively low temperatures.—*Electrochem. and Met. Industry,* October.

Ferro-Vanadium.—J. ESCARD.—The first part of an article on properties and methods of manufacture of ferro-vanadium. In the present instalment electrolytic processes are described.—*La Lumière Elec.,* Sept. 18.

Laboratory.—E. G. MAHIN.—An illustrated description of the elaborate laboratory for electro-analysis at Purdue University.—*Electrochem. and Met. Industry,* October.

Units, Measurements and Instruments.

A Source of Error with the Alternating-Current Bridge.—BEHNE.—If capacities or self-induction coefficients are compared by means of a Wheatstone bridge supplied with alternating current, the result is influenced by the fact that the different arms of the bridge may have a capacity against earth. The author mentions the following particular case in which two condensers, C_1 and C_2, of normally equal capacity were to be compared. (Fig. 7.) For certain reasons, a source of alternating current had to be used, but the voltage was too high for the bridge and some voltage has to be cut off by resistors in series. This was done by inserting at A a rheostat in the bridge arrangement; the bridge itself was shunted by an earthed resistance. The measurement showed that C_1 had twice the capacity of C_2. The condensers were then exchanged and now C_2 had twice the capacity of C_1. Correct results were obtained by connecting the rheostat to B instead of to A. The author calculates in detail what happened here as the result of the capacity of the bridge arms against earth.—*Elek. und Masch.* (Vienna), Sept. 19.

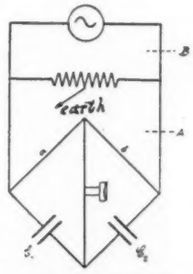


FIG. 7.—DIAGRAM OF ALTERNATING-CURRENT BRIDGE.

Magnetic Testing of Iron.—A. CAMPBELL.—A paper presented to the (British) Inst. of Elec. Eng. The introduction of high-resistivity iron alloys with low hysteresis loss has made it more than ever desirable that sheet material for use in transformers, or alternating-current machinery, should be tested for hysteresis and eddy-current loss by means of actual alternating current. The author has investigated the effect of widely different wave-forms and various materials on the accuracy of the formula given by Roessler for the iron loss of a transformer. For certain materials the author finds that the hysteresis loss increases considerably as the frequency is raised, due probably to magnetic viscosity. Experiments are recorded to show the effect of the thickness of the sheets on the eddy-current loss; the effect of the dimensions of the stampings on the hysteresis loss is also shown.—Lond. *Electrician,* Sept. 24.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—A note on a recent demonstration given at the wireless telegraph station at Cullercoats with Poulsen's high-speed system of transmission. In this system the receiving apparatus is exceedingly simple. A thermo-couple, or contact rectifier, is used as a detector; the unidirectional current thus obtained is passed through an Einthoven galvanometer, the vibrating wire of which is of platinum or gold, prepared by the Wollaston process, about 6 cm long, and having a resistance of 100 ohms if of gold and 400 ohms if of platinum. Its motion is made dead-beat by shunting it with a resistance of about 1500 ohms. A vertical image of this wire (the image being considerably improved by smearing the wire with a little lampblack) is projected by means of a microscope on to a horizontal slit behind which moves a strip of sensitive paper. This strip, passing the slit, is guided by pulleys through the troughs of two bird fountains, being developed in the first and partially fixed in the second. If a permanent record is required, the tape, on leaving the instrument, is run into a second fixing bath. The rectifier actually used in the experiments shown consisted of a small fragment of galena and one of metallic tellurium pressed together. The highest speed at which messages have been received at Cullercoats from Lyngby is 100 words per minute. At the actual demonstration the messages were received at the speed of 50 words per minute; with shorter distances, as between Lyngby and Copenhagen, a speed of 300 words per minute has been attained.—Lond. *Electrician,* Sept. 17.

Miscellaneous.

Iron Alloys.—C. F. BURGESS AND J. ASTON.—An account of an investigation of some physical characteristics of iron alloys with special reference to forging, welding and machining. The authors started with pure electrolytic iron, and then tested alloys with aluminum, antimony, arsenic, bismuth, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silicon, tin, tungsten and vanadium. The results are given in the convenient form of a table.—*Electrochem. and Met. Industry,* October.

Refractory Materials.—S. WOLOGDINE AND A. L. QUENEAU.—The conclusion of their long article on the conductivity, porosity and gas permeability of various refractory materials. The results are summed up in a large table.—*Electrochem. and Met. Industry,* October.

Galvanized Metal.—W. H. WALKER.—A paper read before the American Society for Testing Materials on the testing of galvanized and other zinc-coated metals. After describing the "Preece" test, he points out the desiderata of a new test, describes a test for detecting pinholes and cracks, and a test for determining the combined effect of imperfections.—*Electrochem. and Met. Industry,* October.

Liquefaction of Gases.—C. LIGHTFOOT.—An illustrated article on the liquefaction of gases and the commercial production of oxygen. The author describes the Linde machine for making liquid air and the production of pure oxygen by the fractional evaporation of liquid air.—*Elec. Journal,* September.

BOOK REVIEWS.

THERMOELEMENTE UND THERMOSÄULEN. By Prof. Dr. Franz Peters. Halle: Wilhelm Knapp. 184 pages, 192 ills. Price, 10 marks.

This book is a historically descriptive treastice of the development and applications of thermo-electric couples. It does not discuss the quantitative theory of thermo-electricity, but deals with the practical uses of thermo-electric batteries and with their construction. The value of the book is considerably enhanced by good indexes of subjects and of authorities. The work will be very useful as a reference book to students interested in thermo-electric cells.

MANUAL OF WIRELESS TELEGRAPH. For the Use of Naval Electricians. By Lieut.-Commander S. S. Robison, U. S. Navy. With revisions and additions by L. W. Austin, Ph.D. Annapolis: U. S. Naval Institute. 129 pages, 60 ills.

The title of this excellent elementary treatise on wireless telegraphy is somewhat misleading, as the amount of matter contained relating to wireless operation forms but a small percentage of the contents. Nevertheless, the practical information included probably represents about all yet available for systematic presentation. Chapters I and II deal with the fundamental principles of electricity, magnetism and hertzian waves, particular attention being paid to condenser and etheric wave phenomena. The presentation of the latter subjects is very satisfactorily accomplished without the use of mathematics or abstract conceptions, thus bringing their understanding within the capacity of one having little or no previous knowledge in the premises. Chapter III deals in a similar manner with damped and undamped oscillations, and Chapters IV and V are confined to sending and receiving circuits, respectively. Without going into the details of specific types of apparatus, these latter chapters give a satisfactory idea of the principles upon which present apparatus are founded. Among the appendices is one on the installation and operation of navy wireless apparatus and another giving the code of naval wireless regulations. To one who wishes to obtain an intelligent working knowledge of the principles of wireless and their application, this book can be confidently recommended.

ELEKTRISCHE BAHNEN IN NORDAMERIKA. By Prof. Dr. Wyssling. Zürich: Meyer & Zellers. 302 pages, 123 ills.

This volume forms part of a report of a Swiss commission appointed for the study of electric railways in different countries. It covers all of the principal electrified steam roads and all of the interurban electric roads as well as the principal urban high-speed electric traction systems of the United States. All of the tabular and numerical subject matter has been recast into the metric system. Prices and costs have been translated into Swiss equivalents. The treatment is statistical and descriptive, rather than critical or deductive. In many respects the book furnishes a better comparative description of American electric railways than can readily be obtained by consulting American books on different railroads *seriatim*. The volume is not only of historical interest, but forms an excellent compendium of American electric railroads and systems in a very convenient form for comparison with similar systems in Europe.

NEW APPARATUS AND APPLIANCES

Curtis Turbine Used as Regulator.

BY W. J. DAVIS, JR.

An interesting example of the effectiveness of a Curtis steam turbine when used as a regulator on a large power system is found in the new Oakland power house of the Pacific Gas & Electric Company, of San Francisco. The installation consists of a 9000-kw vertical type Curtis turbo-generator, manufactured by the General Electric Company; eight 750-hp McNaull water tube boilers, and a Worthington condenser outfit having a cooling surface of 20,000 sq. ft.

The 60,000-volt transmission system of the Pacific Gas & Electric Company entering Oakland is delivering more than 100,000 kw during maximum demand. Of this amount 20,000 kw maximum are supplied to Oakland and immediate vicinity, the load factor being about 60 per cent. While the new plant is of great value in carrying the local peak load during hours of maximum demand, it is almost continuously kept connected to the transmission system on account of the steadying effect on the voltage and consequent improvement in the lighting service. When acting as a regulator the duty is especially severe, the turbine taking sudden momentary swings in load from 500 to 9000 kw. In a word, the action of this turbine on an alternating current system is equivalent to that of a large storage battery on a direct current system.

The ability of the Curtis turbine to successfully take these sudden fluctuations in load is due to the large flywheel effect (about 10 times that of a reciprocating engine of equal capacity), close speed regulation, large radial clearances between moving and stationary steam-using elements, and sturdy mechanical construction.

This use of a Curtis steam turbine is particularly interesting on account of the high economy obtained under varying load. Even when the turbine is operating as a regulator the overall economy of the plant is exceptionally good.

The Cooper Gas Engine.

The C. & G. Cooper Company, Mt. Vernon, Ohio, became convinced several years ago that in certain fields of work a thoroughly practical gas engine would prove advantageous, and

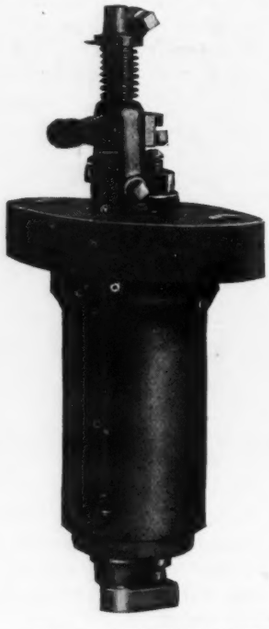


FIG. I.—ADMISSION VALVE.

began a careful investigation of the gas-engine situation in this country and in Europe. After examining existing designs, the company finally decided to design its own gas engine, and

unite, if possible, all the best engineering features which modern practice had proved to be sound and desirable.

Martin A. Thiel, the well-known gas engine expert and designer, was selected to supervise this important work. A German engineer of broad technical training, Mr. Thiel's many years of experience in designing and building the largest and most successful gas engines operating in this country especially fitted him to accomplish the desired result. Mr. Thiel's wide experience also in operating large gas-engine plants has proved valuable in solving with originality and skill many of the problems of gas engineering, such as ignition, timed lubrication, cooling and regulation.

Little publicity has been given the extensive gas-engine developments being carried on by the Cooper company, pending endurance tests in service of the new machines. These tests have thoroughly demonstrated the success of the design, which, it is believed, will be a valuable acquisition to the gas-engine field. Its regulation, running qualities and general reliability have been proved to be equal to that of a steam engine of the highest grade, while the thermal efficiency is, of course, far superior to that of any steam engine.

The new Cooper engine is a double-acting, four-stroke cycle machine, working on the constant mixture principle from the center of the engine so that they travel an equal distance and with equal resistance to the respective intake valves of the cylinders. The mixtures in the various cylinders, therefore, must be identical in volume and composition under all conditions of load. Upon a similar principle the cooling water is introduced into the piston rods from a central point and passes through each piston and piston rod, without reversing the flow, to the outlets at the forward and rear ends of the engine. The overhanging counter-balanced type of crank has been adopted.

The bed is of the heavy-duty rolling-mill type, having an open top, permitting access to the crosshead, and easy removal of the cylinder head and piston through the bed. The bed is rigidly bolted to the foundation, while the distance pieces and tail-rod supports, which are of cylindrical construction, rest on base plates in machined ways. The main bearing is of special design. The lower shell rests in a bored seat, and may be easily removed after relieving it of the weight of the shaft. This shell is babbitted and cored for water cooling. The side gibs are provided with wedge adjustment on either side and are lined with babbitt. The cap is babbitted at the ends only, and is used to clamp the quarter boxes and the bottom shell into place. In addition there is a transverse rib on either side of the cap extending the length of the bearing, which provides a retaining wall for the oil, and compels it to enter the bearing above the

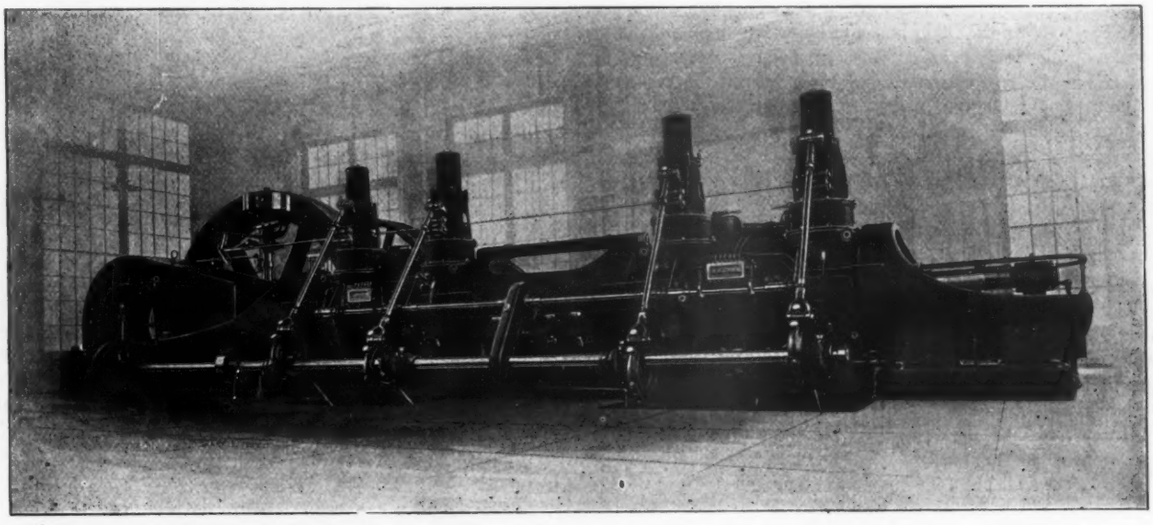


FIG. 2.—GENERAL VIEW OF GAS ENGINE.

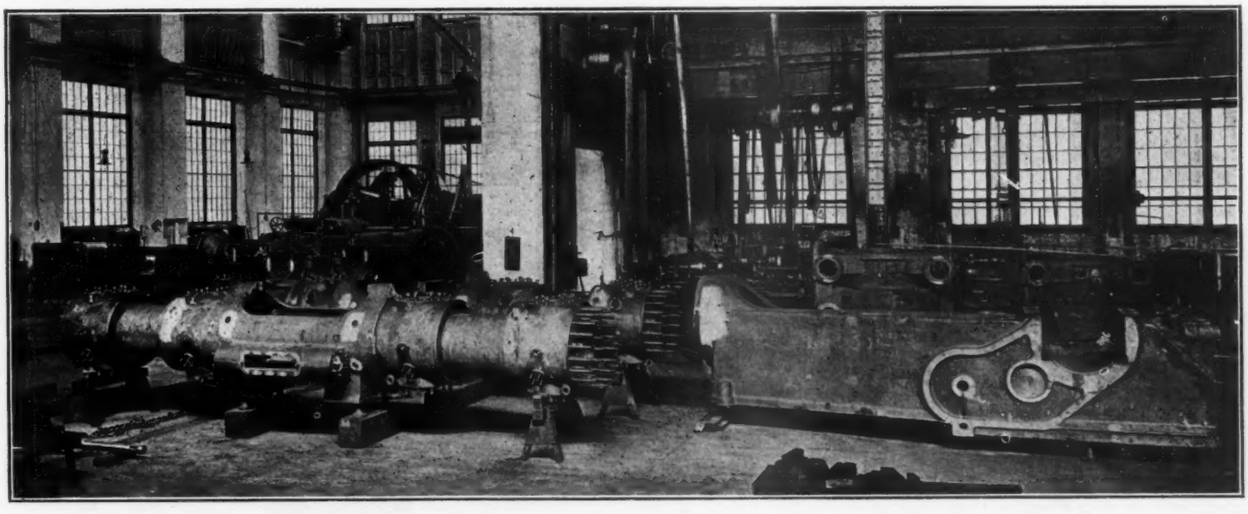


FIG. 3.—GAS ENGINE IN PROCESS OF ERECTION.

side gibs. The cross-head is fitted with an improved flat shoe, the top face of which is bored to allow the cross-head pin to align itself with the crank pin, should the latter be thrown out of the horizontal plane by shaft deflection.

All pistons and piston rods are similar, and are interchangeable. The pistons contain no ribs and float on hollow rods between the main, intermediate and supplementary crossheads. The rods are drilled for water circulation and forced into the pistons. The cylinder is a one-piece barrel, with inlet and exhaust chambers bolted to it so as to remove all cooling strains in the castings. The water jacket is closed at its center by a belt in three segments. The cylinders are supported only at the ends by the main bed and guide castings, and as the piston and rods are carried by their respective crossheads, the cylinder barrels are permitted to expand and contract with freedom. The exhaust piping is of flexible construction throughout, insuring free movement for expansion and contraction due to changes of temperature.

The ignition is of the "make and break" mechanically operated type, and two or more igniters are operated simultaneously at each end of each cylinder. This system is connected with a safety stop, which automatically breaks the electric circuit when the engine speed exceeds 10 per cent above normal, or the cooling water supply fails. The engine is regulated by varying the quantity of a constant mixture controlled by the governor through an automatic relay. The lay shaft is driven by spur and bevel gears, and is supported by bearings on the engine bed and base-plates, thus avoiding the common practice of supporting it on bearings from the cylinders, where these bearings are subjected to the changes due to expansion and contraction.

This plan has the additional advantage of permitting the removal of the cylinders without disturbing the lay shaft bearings. The inlet and exhaust valves at either end of each cylinder are actuated by a single eccentric on the lay shaft. The exhaust valve is of the separate cage, water-cooled type. The gas regulator is of a special oil-sealed, enclosed construction with balanced valve.

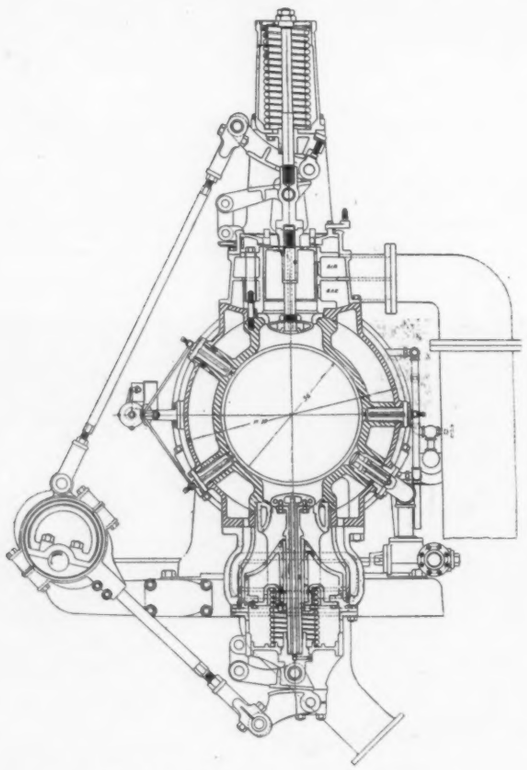


FIG. 4.—CROSS-SECTION OF GOVERNOR.

Aside from the remarkable combination in this engine of features essential to the best results in a gas engine, the construction details common to all reciprocating engines, such as bearings, connecting rods, etc., have been worked out with unusual painstaking and skill. The design and performance of the engine are stated to have been regarded as very remarkable by many prominent gas engineers who have inspected it. It will be built in single-tandem and double-tandem units of from 150-hp to 3000-hp capacity.

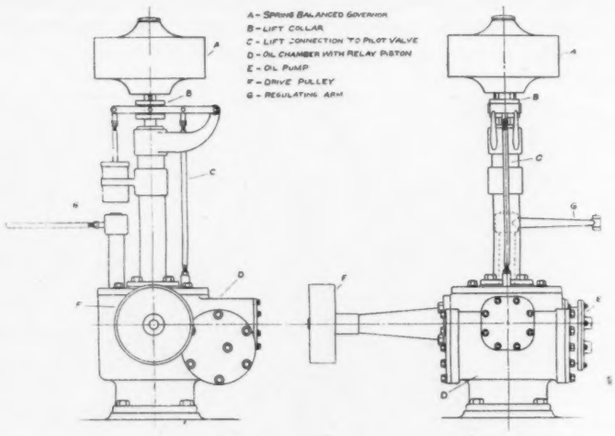
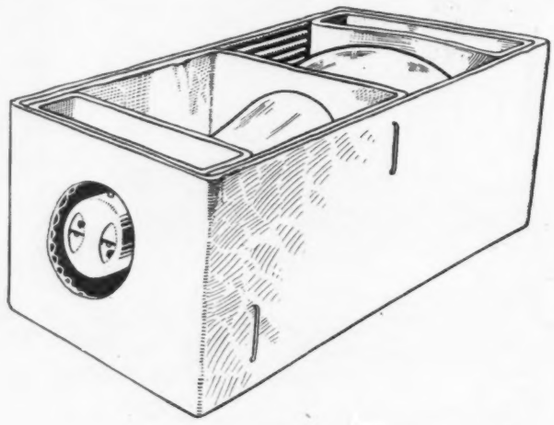

A - Spring Balanced Governor
B - Lift Collar
C - Lift Connection to Pilot Valve
D - Oil Chamber with Relay Piston
E - Oil Pump
F - Drive Pulley
G - Regulating Arm

FIG. 5.—AUTOMATIC OIL-PRESSURE RELAY GOVERNOR.

Sealed Tungsten Lamp Cartons.

A sealed tungsten lamp carton of a type shown in the accompanying illustration is being adopted by many manufacturers abroad, in order to minimize claims made for lamps broken in transit. The lamp may be examined and tested, and even lighted while in the carton. It cannot be removed without breaking the seal, and, therefore, enables a hard and fast line to be laid down as between the seller and the buyer as to claims for breakage in transit.

In case a broken lamp is returned to the sender within a reasonable period with the seal of the carton unbroken, it is fair to assume that the breakage occurred in transit and a claim therefor allowed. The cartons, which are of square cross-section, and thus not likely to roll off the counter or shelf, have a label including brief instructions as to test and conditions of claims. Other advantages for the cartons are that they do not need any packing when cased; the breakage in transit is considerably reduced; improper claims for breakage are prevented, and arguments between the buyer and seller are minimized.



SEALED TUNGSTEN LAMP CARTON.

The Split-Pole Direct-Current Converter.

An interesting application of the split-pole scheme for varying the voltage ratio in dynamo-electric machinery is found in the C.M.B. direct-current "auto-converter" recently placed on the market by Crompton & Company,Limited, Salisbury House, London Wall, London, E. C., England. The principles upon which the converter operates were outlined on page 333 of our

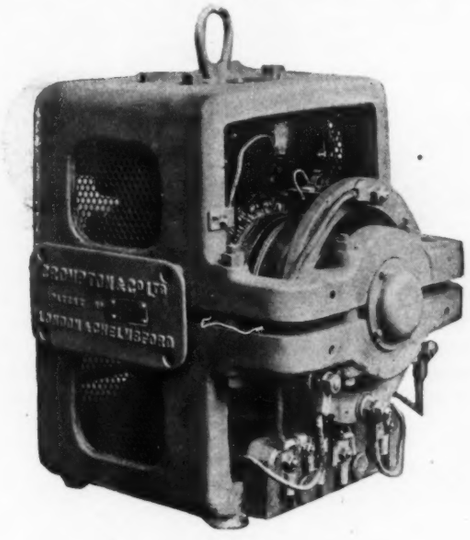
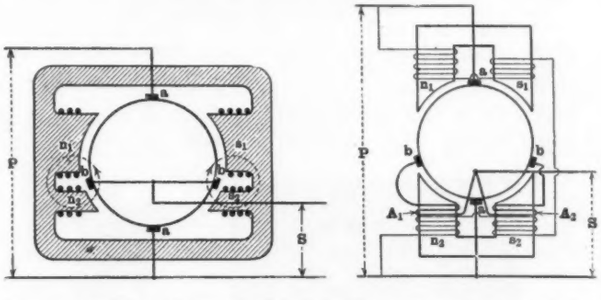


FIG. 1.—SPLIT-POLE DIRECT-CURRENT CONVERTER.

issue for Aug. 5, 1909, while a view of the machine is given in Fig. 1 herewith.

The converter differs from the well-known bipolar type of direct-current machine in being provided with four brushes instead of two, the two extra brushes being placed at equi-potential points on the commutator so as to divide the e.m.f. between the main brushes into the proper ratio for the desired conversion. An idea of the scheme employed for obtaining the required voltage ratio may be gained from Fig. 2. The supply (primary) e.m.f. is impressed at *P* between the vertical brushes *aa*, while the delivered (secondary) e.m.f. is obtained at *S* between the lower *a* brush and the brushes *bb*. Slots in the two field poles serve for minimizing the spark-



FIGS. 2 AND 3.—MAGNETIC AND ELECTRIC CIRCUITS OF CONVERTER.

ing at the brushes *bb*. The actual mechanical arrangement differs somewhat from the explanatory diagram of Fig. 2, being more nearly equivalent to that of Fig. 3. In comparing the latter diagram with the former, it will be noted that the reluctance of the path for any flux produced by armature m.m.f. is considerable. Moreover, the pole parts which regulate the secondary delivered e.m.f. are provided with series windings ,in addition to the ordinary shunt coils, as shown at A_1A_2. These coils serve to interconnect the auxiliary brushes and one of the secondary terminals of the machine. Under normal circumstances when there is no circulating current flowing through the armature across the short-circuited auxiliary brushes, each brush and each series-field coil will be carrying one-half of the secondary load current. If, however, a circulating current arises, it will flow in opposition to the load current in one coil, A_1, say, and in conjunction with the load current in the other coil, A_2; in effect, therefore, the current in coil A_1 will be less than in A_2, and if these coils are suitably coupled up will have the effect of correcting or preventing the short-circuit current from rising to any considerable value. In other words, as the current in the coil A_1 is less than the current in the coil A_2, the m.m.f. on the pole n_2 is less than the m.m.f. on the pole s_2, and this tends to cause a greater voltage to be generated under the pole s_2 than under the pole n_2, thus opposing the voltage which is creating the circulating current. The series coils can be arranged to give a compounding or a differential effect on the secondary circuit as desired.

The above-described machines can be used for obtaining a constant secondary e.m.f. for any value of the secondary current, or for giving a secondary current which is to remain approximately constant for a given range of secondary voltage, or they can be utilized as variable-ratio, split-pole synchronous converters by adding collector rings for the introduction of alternating current.

As a general rule the diagram shown in Fig. 3 is suitable for machines giving constant voltage. Such machines would be the direct current equivalent of an alternating-current auto-transformer, but would have the advantage that the secondary voltage could be easily altered at will, independently of the primary voltage or compounded for voltage drop. By so interconnecting the series coils that their m.m.fs. oppose the m.m.fs. of the

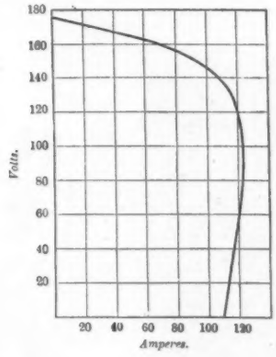


FIG. 4.—CHARACTERISTICS OF CONSTANT-CURRENT CONVERTER.

shunt coils on pole-parts $n_2 s_2$ the machine may be caused to deliver automatically a practically constant secondary current.

Fig. 4 shows the relationship between the secondary amperes and voltage of a 220-volt machine made for the purpose of supplying energy to two 120-amp, 60-volt arc lamps in series. The efficiency of this machine, when supplying energy to the two lamps was over 92 per cent. The dimensions of the machine are 24 in. high by 22 in. by 24 in. long, and it weighs 900 lb. The weight of the set and the space taken up are remarkably small.

Condit Carbon-Break Circuit-Breaker.

Every carbon-break circuit-breaker has two functions, one of which is to carry its full rated current without undue heating, and the other to open the heaviest short-circuit which may be put upon it without burning the brush to such an extent that the breaker is rendered inoperative. In the ordinary form of carbon break, where the carbons are pivoted in a plane to the base, the pressure on the carbon and the amount of carbon in contact is greatest when the breaker is fully closed. When the secondary and the brush are leaving, which is the critical point, the resistance of the carbon path is comparatively high, as the pressure has been removed from the spring and the carbons have so slid as to present but a line contact.

In the breaker illustrated herewith, made by the Condit Elec-

trical Manufacturing Company, Boston, the desirable features of low secondary contact resistance at the critical point have been obtained by the use of sliding carbons which yield at right angles to the board. These carbons are so proportioned and

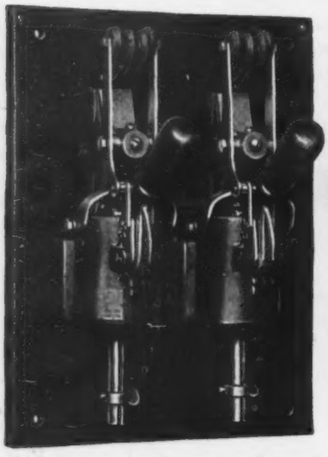


FIG. 1.—DOUBLE-POLE CIRCUIT BREAKER

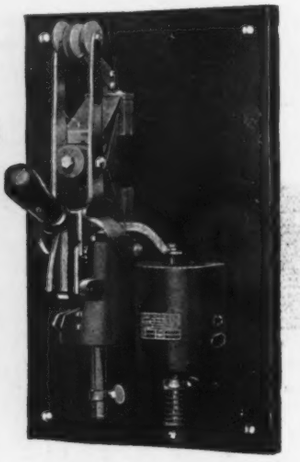


FIG. 2.—OVERLOAD-UNDER-LOAD CIRCUIT BREAKER.

arranged that a maximum surface contact and, consequently, minimum resistance, is obtained at the instant the secondary contact leaves the block. The spring being at right angles to the base and not in the plane of the movement gives equal pressure at all times. Among the other features of the breaker are a single coil to a pole, interlocking mechanism so that it is impos-

FIG. 3.—SINGLE-POLE CIRCUIT BREAKER.

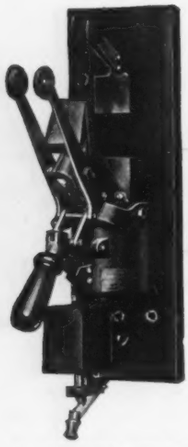


FIG. 4.—OVERLOAD NO-VOLTAGE CIRCUIT-BREAKER.

sible to open in any way one pole of the breaker without opening all of the poles, and heavy, massive parts. The cuts show a single-pole, a double-pole, an overload shunt-trip and no-voltage and overload-underload breakers. Besides these the breaker is also made for reverse-current attachment and in other special forms that may be required.

Cable-Hanger.

The cable hanger shown herewith, known as the "H. P. Rustless Cable Hanger," is stamped out of sheet zinc, and being complete in one piece has no parts to become detached or iron hooks to rust out, thereby allowing the cable to sag or fall. Being of zinc it is durable and affords a good metallic connection of the messenger wire with the lead sheath on the cable. This feature localizes the damage by lightning and high-tension crosses, thereby greatly reducing reconstruction costs. The hanger binds tightly on the cable, and being flat, does not interfere with the cable car riding readily over the messenger wire after it has been applied. It packs closely in small boxes, 500 in each, of convenient size for carrying under the arm. The hanger is attached as follows: Hold the circular end against the cable and wind the free end twice around and once over the

RUSTLESS CABLE HANGER.

messenger wire as shown in the cut. The cable hanger described is made by H. P. Copeland, 127 Franklin Street, New York City.

Machine-Tool Controllers.

The attached cuts show the newest type of Ward-Leonard machine tool controllers. The full reversing type, giving armature and field control in either direction, is arranged for either

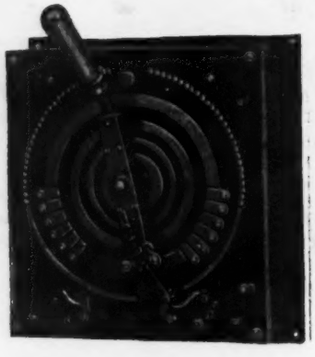
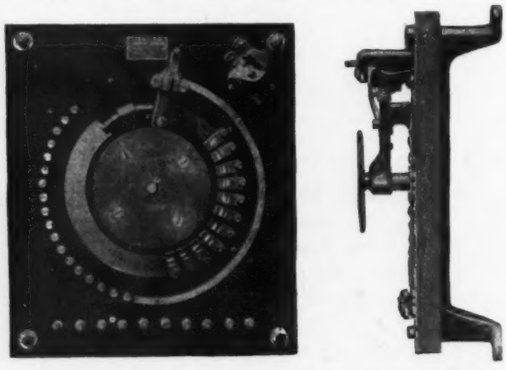


FIG. 1.—FULL REVERSING-TYPE MACHINE-TOOL CONTROLLER.

hand or chain drive. The resistance is mounted directly on the face plate or at a distant point. The same is true of the non-reversing type. The cut shows the front and side view of the



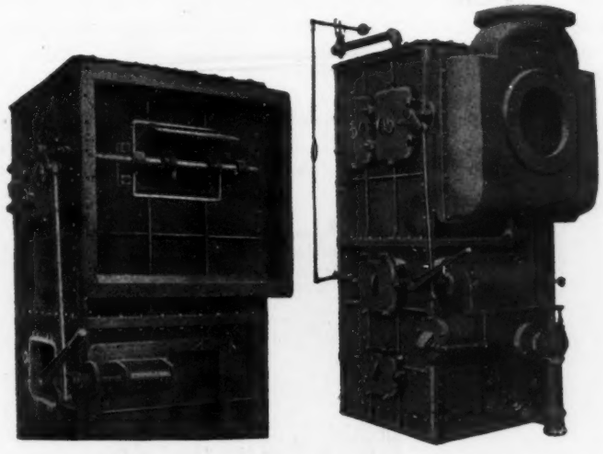
FIGS. 2 AND 3.—FRONT AND SIDE VIEWS OF NON-REVERSING TYPE.

non-reversing type. A plate is furnished to which the sprocket wheel is attached. The resistance in either case consists of standard Ward-Leonard enamelled resistance units.

Combined Valve-Gear for Heaters and Receivers of the Steam Stack and Cut-Out Valve Type.

Some time ago the Harrison Safety Boiler Works, Philadelphia, Pa., put out a new type of combined heater and receiver for use in connection with exhaust-steam heating and drying systems. The peculiar feature about this heater was the extra large separator attached to and forming a part of it, and intended to purify all the exhaust steam delivered by the engine, including not only that entering the heater to heat the boiler feed-water, but also the surplus passing to the heating and drying system. In order to be able to cut the body of the heater out of circuit, as for cleaning and inspection while the heating system continues in operation, a manually controlled valve was provided to shut the separator off from the heater body and another to close the passage between the separator trap and the overflow of the heater, the latter being necessary in order that the trap might continue to drain the separator when the heater was cut out of circuit without allowing steam to enter the heater by way of the separator drain pipe and trap.

It is obviously necessary that both valves be closed when it is desired to cut the heater out; also, that if a man is to enter the heater body while the separator is receiving steam, some provision must be made against accidental opening of the valve.



FIGS. 1 AND 2.—COMBINED HEATER AND RECEIVER.

On small heaters it was found practicable to connect the spindles of the two valves together and to turn them by a single lever, the handle for operating the valves being attached to the spindle of the upper valve, while a connecting rod driven from a short crank on this spindle operates a second crank keyed to the spindle of the lower valve.

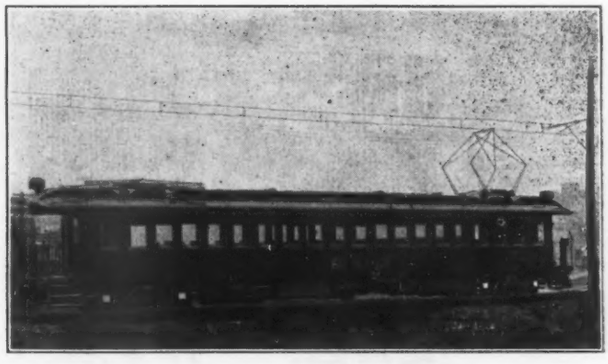
The steam valve between the separator and the heater is of the semi-cylindrical rotating type, and is held against its seat by springs, and also by the pressure of the steam. Where a pressure of 5 lb. per square inch, or more, is carried in the heating system, the total pressure over the valve of a large heater would render operation difficult, by forcing the valve tightly against the seat. In order to obviate this a special valve gear has been devised. The operating handle is attached to the spindle of the lower valve instead of to the upper, and the lower end of the connecting rod engaging the pin on the short crank of the lower spindle is slotted, so that the lower spindle has a certain excess of motion over that of the upper spindle. The amount of this excess motion is so adjusted that in closing the upper valve shuts off first, and then stands still while the lower valve rotates through the remaining arc of its motion, which it is enabled to do by reason of the lost motion in the connecting rod. In this way the upper valve is closed while there is still pressure in the heater to balance the pressure of steam on the outside of the valve. Subsequently, the lower valve closes, cutting off the heater, after which any steam contained therein will be condensed or escape from the vent pipe with which an open heater is always provided. Once both valves are closed, the operating handle is removed from its spindle before the cleaning doors of the heater are opened, making it impossible for the steam valve to be operated until the handle is replaced.

In opening the valves, the lower valve will swing through a sufficient arc to establish communication for steam through the separator drain pipe and trap into the heater, equalizing the pressure on the steam valve before the latter begins to move. Once the pressure is the same on both sides of the valve, the latter will slide easily, and the operation of opening can be completed. During this operation the valve in the vent pipe of the heater should be closed to permit pressure to build up in the heater when the lower valve is first opened.

Single-Phase Cars for New Haven Suburban Service.

At the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company there are now being installed the electrical equipments of a number of motor-cars for the suburban service of the New York, New Haven & Hartford Railroad. These cars are designed to operate on either the 11,000-volt alternating-current catenary trolley of the main New Haven electrification or the 600-volt direct-current third-rail section entering the New York terminal.

By reason of the fact that the New York, New Haven & Hartford equipments are required to operate on the New York



SINGLE-PHASE MOTOR CAR FOR 11,000-VOLT SERVICE.

Central direct-current third-rail the control equipment for effecting a change from alternating current to direct current is necessarily more extensive than would have been the case if the control had been arranged for straight alternating-current operation throughout, but, as seen in the accompanying illustration, this auxiliary apparatus has been so well distributed under the floor that there is ample room for everything in the space between the trucks.

The cars, which are intended to pull trailers, are equipped with four compensated series motors. These and the step-down auto-transformers are supplied with forced ventilation from the blower system. When the equipment is operated under forced ventilation the one-hour railway rating of each motor is 200 hp. Each car is guaranteed to haul two 50-ton trailers, and when so operated will accelerate normally at a rate of 0.7 miles per hour per second.

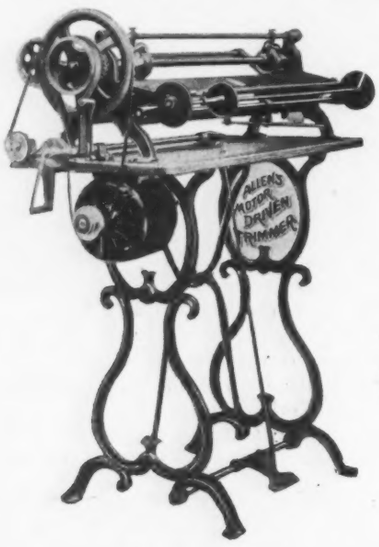
The arrangement of the motors differs from that of any other cars in use in this country, in having the motor geared to a quill surrounding the axle which is coupled to the wheels by means of springs of the same type as are used successfully on the New Haven locomotives.

Each car weighs 86 tons, is 70 ft. in length and has a seating arrangement for 72 persons. Cars and trucks, which were built by the Standard Steel Car Company, are of fireproof, steel construction throughout. They are handsomely finished and are said to be the most easy-riding cars ever built.

Electric Wall-Paper Trimmer.

The accompanying illustration shows an electrically driven wall-paper trimmer recently put on the market by A. Allen & Company. The construction is such that the operator has full control of the machine, being able to start and stop instantly, go slow or fast, the only effort required being a pressure of the foot.

It will readily be seen that this is a great advantage over the old way of turning the crank, as it gives the operator free use



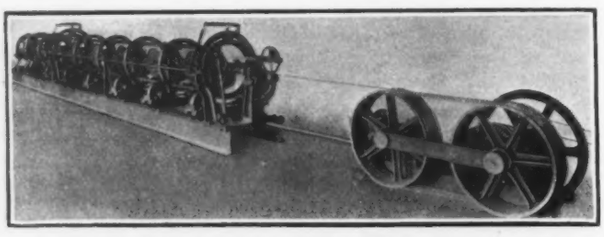
WALL-PAPER TRIMMER.

of both hands. While the user can turn out double the work in the same time with the greatest ease, the cost for energy is very small, as the Westinghouse motor used is but of ⅛ hp. This application is an exemplification of the fact that small motors are being utilized to drive all manner of machines formerly driven by hand or foot power, and in many instances are responsible for the developments of entirely new machines not possible without the motor. The outfit complete is sold by Messrs. A. Allen & Company, 2001-5 Carpenter Street, Philadelphia, Pa.

Reel Stranding Machine.

The accompanying illustration shows a new type of reel stranding machine made by the New England Butt Company, of Providence, R. I. In this type of machine the reels are carried in stationary cradles hanging at the center of the machine and the frame revolves about them. By this construction the machine is perfectly balanced and a very high speed becomes attainable.

In the size shown the reels are 16 in. diameter by 9½ in.



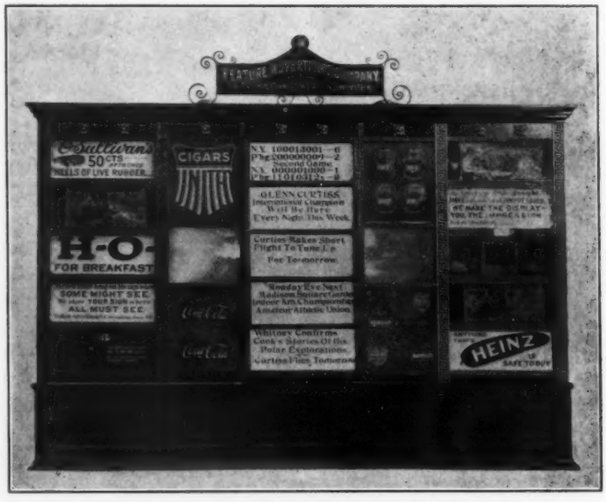
REEL STRANDING MACHINE.

traverse and hold approximately 250 lb. of wire. The whole machine is mounted on heavy 10-in. I-beams, and is entirely self-contained. It has tight and loose pulleys at the rear end of the revolving member, and a silent chain connection to a longitudinal shaft extending under the machine which drives the take-up. Adjustable rollers support the revolving member and are provided with bronze ring-oiling bearings. Suitable grooved sheaves are furnished at various positions for guiding the wires to lay the plate. Two powerful brakes are operated by a handle in a position convenient to the operator. The machine is equipped with a device which measures the product as it comes from the machine, and which can be swung out of the way when not in use.

The take-up is of the grooved double-drum type, which has proved to be much more satisfactory than the ordinary type of draw-off sheave. The drums are 30 in. in diameter and have eight grooves in each. A full set of change gears is furnished for producing lays from 1¼ in. to 5 in. The floor space occupied by the machine and take-up is 38 in. x 10 in. x 4 in. The machine fully loaded carries from 1700 lb. to 1800 lb. of wire, and is capable of being run at a speed of 400 r.p.m. The machine is made in various sizes from one taking reels 3 in. diameter, running at a speed of 1000 r.p.m., to a large machine with reels 32 in. in diameter.

News-Ad-o-Scope.

The Feature Advertising Company, with offices in the Metropolitan Tower, is giving the first public exhibition in New York of its "News-Ad-o-Scope"—the latest up-to-date advertising device. As the name implies, there is, in this machine, a newspaper (with bulletins direct from the football, baseball and racing fields), revolving advertisements (illuminated from behind) and stereoscopic projections in colors of advertisements



NEWS-AD-O-SCOPE.

and of views of special interest. The stereoscopic views are changed by an electric motor every six seconds, and the producer is thus enabled to show to the consumer every step in the manufacture of an article from the field to the table.

The "Window Ad-o-Scope" is a miniature form designed to show advertising cuts and stereoscopic views in the limited space of a show window. The intrinsic value of this machine lies in its economy of space, the projection of the size displayed (20 in. x 20 in.), requiring ordinarily a distance of from 15 ft. to 20 ft., but which it shows within a space of 18 in. This possibility has also been utilized in another design known as a "Theatrical Ad-o-Scope," in which the portraits of the different artists are reproduced in color on translucent glass (illuminated from behind), the stereoscopic projection giving the play complete, scene by scene, and act by act. The one exhibited at Madison Square Garden is a very artistic reproduction of Anna Held in "Miss Innocence," and created a sensation on Broadway when it was displayed for the first time week before last in front of the New York Theater.

Car Lighting Exhibits.

The Association of Car Lighting Supply Manufacturers was very well represented by many members at the Chicago convention of the Association of Car Lighting Engineers, and the exhibits made a most creditable showing. The exhibits were placed in various rooms on the mezzanine and second floors of the Hotel LaSalle, where the convention was held, and excited a great deal of interest among the car lighting engineers. Nearly all of the exhibitors report very favorable results and expect to exhibit regularly. The following supply concerns were represented:

THE HOLOPHANE COMPANY was represented by Mr. V. R. Lansingh.

THE KERITE INSULATED WIRE & CABLE COMPANY was represented by Mr. Watson, its Chicago representative.

THE TIPLESS LAMP COMPANY, New York, was represented by Mr. R. S. Carrick, whose lamps are used by many of the railroads.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, while not making an exhibit, had Mr. Peter S. Klees looking after its interests.

THE PYLE NATIONAL HEADLIGHT COMPANY was represented by Mr. J. Will Johnston and showed one of its electric headlamps in operation.

THE ONEIDA STEEL PULLEY COMPANY was represented by Mr. H. P. Gale and showed several types of steel pulleys suited to axle-driven generators.

THE WARD EQUIPMENT COMPANY was well represented by Mr. G. B. Culver and showed some train-heating and heat-regulating devices and systems.

THE KUHLMAN ELECTRIC COMPANY, of Elkhart, Ind., was represented by President Kuhlman, who was present in the interest of its transformers.

THE BRILLIANT ELECTRIC COMPANY was represented by Mr. H. H. Cudmore, the well-known orator, who is president and general manager of the company.

THE UNIVERSAL STORAGE BATTERY COMPANY was represented by Mr. W. Bentley, and several of its well-known batteries and some of the new elements were exhibited.

THE NATIONAL METAL MOLDING COMPANY, of Pittsburgh, had an exhibit in Parlor 221 in charge of Mr. I. A. Bennett, the Chicago manager, assisted by Mr. J. W. Hardy.

THE ADAMS & WESTLAKE COMPANY was represented by Messrs. R. N. Newbold and Waters. A representative assortment of lighting fixtures for both electricity and acetylene gas was shown.

THE ECONOMY ENGINEERING COMPANY was represented by Messrs. T. A. Duffy and French. There was shown a very convenient hoisting device, suitable for elevating storage batteries and other articles.

THE SANGAMO ELECTRIC COMPANY was well represented by Messrs. M. B. Southwick and R. C. Lanphier. Its exhibition of amp-hour meters attracted a large amount of interest and was very attractively arranged.

THE NEW YORK LEATHER BELTING COMPANY was very ably represented by Messrs. W. H. Glatt and J. L. Abt. The exhibit consisted of several belts which are especially suited for driving car-lighting generators.

THE ELECTRIC STORAGE BATTERY COMPANY was represented by Mr. H. E. Hunt with the very able assistance of Messrs. Milton, Cressy and Baird. The exhibit, which included a very complete assortment of batteries and elements, attracted considerable attention.

THE GOULD STORAGE BATTERY COMPANY was very creditably represented by Mr. G. R. Berger. The exhibit included an axle generator mounted as in service, batteries and plates, and controlling devices. Mr. Berger was assisted by Messrs. Milne, Shedd, Turbayne and C. W. Gould.

THE CHAS. L. KIEWERT COMPANY was represented by Mr. H. C. Olmstead and exhibited several flaming-arc lamps, showing both the alternating-current and direct-current patterns. There were shown one lamp with a single vertical electrode, and an assortment of Siemens electrodes, etc.

THE NATIONAL ELECTRIC LAMP ASSOCIATION was very ably represented by Messrs. C. W. Bender and R. I. Patterson, and exhibited a representative assortment of modern incandescent lamps. The BUCKEYE ELECTRIC COMPANY and the COLUMBIA INCANDESCENT LAMP COMPANY shared the exhibit with the N. E. L. A.

THE GENERAL ELECTRIC COMPANY was represented by Mr. J. Scribner, with the assistance of Messrs. Schroeder, Benson and Hawley. The exhibit, which was small but effective, consisted of a case of train-lighting lamps of all kinds, supplies, and a turbo-generator with the case removed to show the simplicity and relation of the parts.

THE WESTERN ELECTRIC COMPANY'S exhibit attracted considerable attention. A complete line of specialties of interest to car-lighting engineers was shown. A rather novel exhibit was one of its "Blue Bell" batteries standing over 6 ft. in height. Messrs. Geo. H. Porter and Geo. Lounsbery were untiring in their efforts to interest all visitors.

THE WILLARD STORAGE BATTERY COMPANY was represented by Mr. T. A. Willard, who was very ably assisted by Messrs. Norberg, Ballantine, Gassaway, Fijux and Sears. Several styles of storage batteries and plates were shown, among which were the plate with heavy tapering center web and a special plate with 80 ribs per inch. The latter was arranged to show the high quality of lead used in the plates, as the ribs are "plowed" from the web without tearing the lead.

THE CENTRAL ELECTRIC COMPANY was represented by Mr. J. M. Lorenz, assisted by Messrs. Cox and Pearl. Mr. H. W. Young also spent a large amount of time there. The exhibit was representative of its large line, and included many kinds of "Okonite" wire, train-lighting lamps, especially the 30-volt and 60-volt tungstens; "Opalux" shades and reflectors, 1910 Diehl fan motors, "P. M." remote-control switches and a rotary converter arranged to give energy at either 30, 60 or 110 volts at the generator end.

THE SAFETY CAR HEATING & LIGHTING COMPANY was represented by Mr. A. C. Moore, general manager, with the very effective assistance of Messrs. Van Winkle, Luckey, Wilham, Pinyard, Spinney, Lemmon and Bergstrom. The exhibit, which centered about a mounted generator, included batteries, controlling devices and a large assortment of car-lighting lamps. The special feature was a new berth-lighting fixture without a cover. Two push buttons were suitably mounted above the lamp.

THE WESTINGHOUSE INTERESTS, comprising the Westinghouse Lamp Company, the Westinghouse Electric & Manufacturing Company and the Westinghouse Storage Battery Company were well represented. Messrs. J. M. Schilling, Fisher and Schaulin represented the Lamp Company, Messrs. Jones, Dusenberre and Arlington represented the Battery Company, and Messrs. Davis and Talbott the Electric & Manufacturing Company. The exhibits included storage batteries, incandescent lamps, small generators, oil-break and air-break switches and controllers. The special feature of the exhibit was the "wire-type tungsten lamp," a product especially suited to car-lighting service.

THE UNITED STATES LIGHT & HEATING COMPANY was represented by Mr. J. A. Smith, general manager, and Mr. W. M. Lalor, who had charge of the exhibit. They were assisted by Messrs. Bliss, Pomeroy, Hawley, Mead, Sherman, Bauer, Mau, B. Smith and Heister. Exhibits were made of four sizes of axle generators, 1.5 kw, 2.5 kw, 4 kw and 6 kw; National batteries, suspension devices for generators, controlling devices, lamp regulator of a new type, a 60-volt regulator, a "tapering" arrangement for battery-charge regulation, and the Bliss & Moskowitz axle-lighting systems. A special feature of the exhibit was a generator mounted on a part of a truck and controlled by a special device for varying the speed of the generator as in service.

Exhibits at the New York Electrical Show.

THE third annual electrical show, which began in Madison Square Garden, New York, on Oct. 11, and which will continue to Oct. 21, has for its object the creation of general public interest in things electrical. While it is impossible to display under one roof the myriad uses of this force, there is enough diversity of application on exhibition to make the show educational in character and to give the public some conception of the wide applicability of electricity. Certainly no one can visit the show and not be impressed with the immense amount of household work which can be performed through the agency of electrical appliances. The heavier branches of the industry are not neglected either; and the manufacturer can find much of interest and profit in the booths. Below is a brief synopsis of the exhibits, excepting those made by the four electric lighting companies, which will receive attention in a later issue. A brief glance of the array of apparatus scheduled shows the comprehensiveness of the exhibition as a whole.

The Electric Cleaner Company, Chicago, manufactures a complete line of portable electric vacuum cleaners known as the "Positive" and the "Reliable." Both of these machines are on exhibition and the demonstrators explain the various operating features. Mr. J. M. Rodger is in charge of the exhibit and he is assisted by Mr. A. B. Cousin.

The Baltimore Enamel & Novelty Company, New York, is exhibiting porcelain enameled iron reflectors for arc lamps, incandescent lamps, etc. The company also manufactures electric storage battery jars, messenger call-box shells, porcelain enameled iron advertising signs, agency signs, etc., all of which are on exhibition. Mr. C. A. Marsland is in charge of the company's interests.

Charles Biele, New York, is demonstrating his "Cafe Savoy" coffee on electric stoves with percolators. A miniature electric coffee roasting plant and an electric grinder are also shown in operation. Women demonstrators make an infusion of coffee on electric stoves and serve the same in dainty shell cups to all visitors. Mr. Biele is represented at the show by Mr. Charles H. Salzer.

Automatic Electric Washer Company, Newton, Ia., has on exhibition two electric washers. The device is said to comprise all that could be demanded of such a machine; a clean, substantial washing machine of ample capacity, with a powerful well-built electric motor and a ball-bearing reversible wringer combined in one complete equipment ready to attach to any electric lamp socket. The company is represented by Messrs. H. L. Ogg and R. Winger.

The Wonderful Pump Company, New York, is represented by Dr. J. Nelson Walter, Mr. G. B. Janson and Mr. J. T. Chesler. This company manufactures a screw pump, which is shown in operation direct-connected to a motor The device is said to possess very little internal friction and to be particularly applicable for gritty and sandy water. The size of the stream discharged is equal to the bore of the pump, and machines capable of delivering 40, 200 and 300 gal. of water per minute are shown in operation.

Dossert & Company, New York, are exhibiting a full line of solderless mechanical connectors, cable taps and terminals for electric cables and wires. Among the new devices exhibited is a cable tap for connecting aluminum and copper cables. This tap gives an aluminum contact at the point of connection with the aluminum cable and a copper contact at the point of connection with the copper cable. The method of making complete transformer connections with Dossert connectors is also shown. Messrs. C. A. Flynn, H. S. Shope and D. J. Fitch are in attendance.

Hurley Machine Company, Chicago, has on exhibition a line of "Thor" and "Chicago" electric washers and wringers. The company shows a universal rod in connection with its Thor electric washer running an ice-cream freezer, meat chopper, ironing machine and a number of other small articles used about the house. A feature of the exhibit is an ice machine said to be capable of freezing 20 lb. of ice in 20 minutes. This is operated by electricity. The following representatives of the company are present: Messrs. Neil C. Hurley, W. H. Haberle and E. J. Riedy.

Manhattan Electrical Supply Company, New York, exhibits a line of general supplies in its main booth. The list of goods manufactured by this company includes electric light specialties, medical apparatus and electrodes, telegraph and telephone apparatus, electric bells, massage vibrators, dry batteries, electric horns, jump spark coils, automobile switches, motors, dynamos, time switches, door openers, testing instruments, etc. The company also has a special exhibit of wireless telegraph apparatus. This part of the exhibit is under the supervision of Mr. A. B. Cole, and two wireless outfits are in operation inside the Garden, so that messages can be sent and received at both stations. The general exhibit is in charge of Mr. J. C. Moulton, who has several assistants.

The Vacuum Engineering Company, New York, has on exhibition two rotrex vacuum cleaning plants, one showing a direct-connected, one-sweeper plant, and the other being a two-sweeper chain-driven plant. The above are both stationary, and are intended for installation in the basement of buildings, with pipe lines running to such points as are most convenient for hose connections. The pump differs from the ordinary pump used for this purpose in that it has no sliding blades, wearing strips or valves, and the plant has no separating tanks, the dirt being first taken into what is called a separating chamber, where it is dissolved, and then carried automatically and directly to the sewer in the form of dirty water. The exhibit is in charge of Messrs. W. H. Trump and Carroll A. Gibson.

The American Metal Hose Company, New York, has on exhibition a complete line of samples of its flexible metal hose in steel, copper and brass. The steel and copper hose are made for steam, compressed air and oil, while the brass hose is largely used in connection with automobiles. The company is also exhibiting a flexible metal conduit used for covering wires, etc., and a complete line of hose for gas use. In addition, there are some "Ametalhose" flexible arms for portable lamps and an electric heating apparatus in which the heating element is a flexible metal tube. The latter is the product of the Brockdorff-Witzenmann Works of Berlin. The same principle that is employed in this heater is also used in an apparatus to free oil in transformers from water, and a demonstration of this is made. Mr. Charles S. Hungerford represents the company.

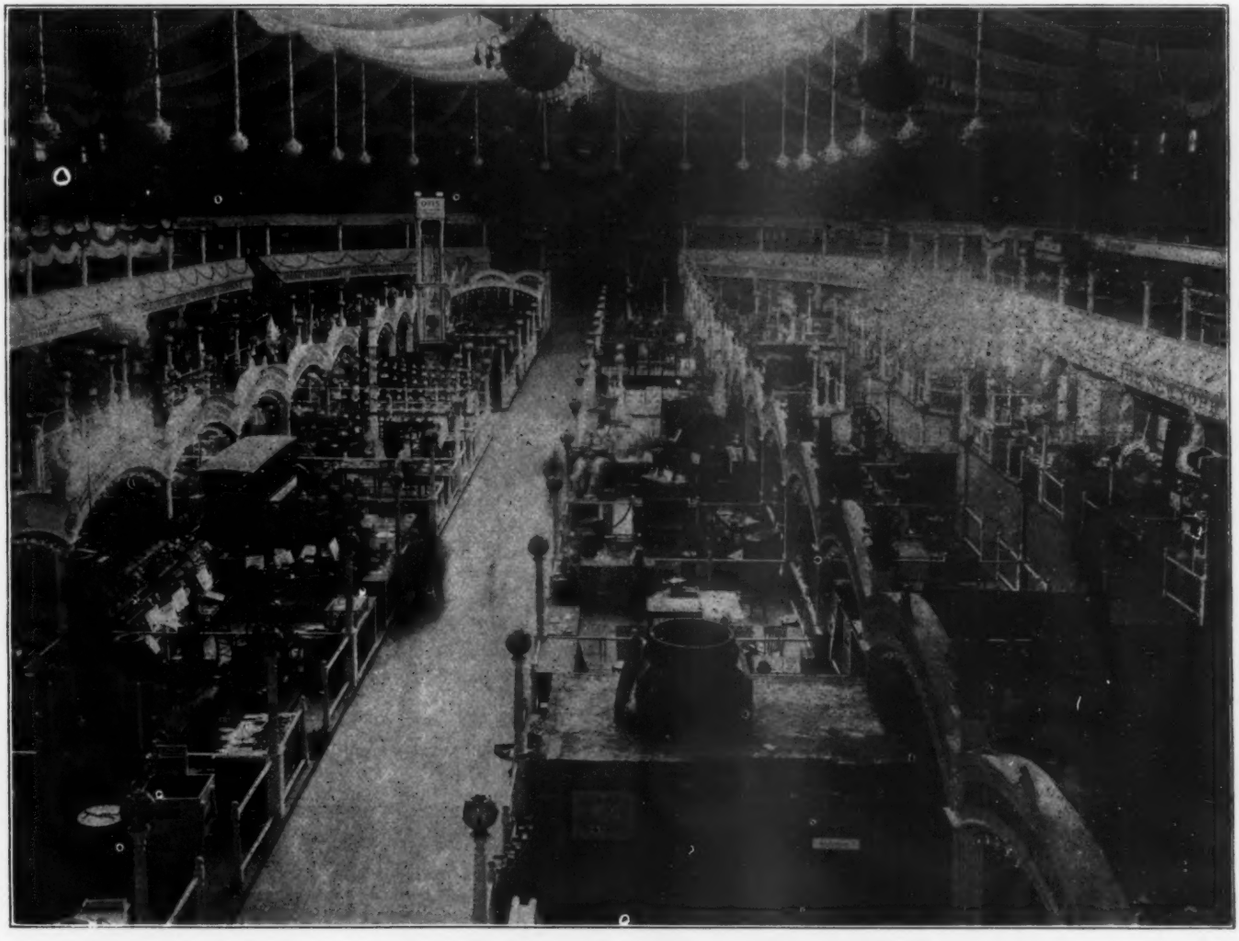
The Lansden Company, Newark, N. J., exhibits two of its machines, representing widely different lines of construction. The standard 1500-lb.. closed panel delivery wagon, such as is used for department stores or similar lines of work, has a speed of 11 miles an hour. The machine is said to carry 100 per cent overload, and its rated mileage with full load for the full distance is stated to be 40 miles. The weight of the vehicle is 3200 lb.; wheel base, 88 in.; the wheel gage, 50 in. and 3 in. by 32 in.; solid rubber tires are employed. The other machine on exhibition is an industrial truck, which has been developed for use in factories, mill yards, steamship piers, railroad terminals, etc. The vehicle is said to possess features which make it particularly applicable for such work. It is low and easily loaded, and on account of its peculiar construction can be maneuvered through narrow passageways. The machine is constructed in two forms, a three-wheel outfit and a four-wheel truck, which has an additional single steering wheel added to the opposite end. Those in attendance include Messrs. F. A. Whitten, A. J. Doty, J. R. Kinsey, L. H Van der Burgh and J. M. Lansden, Jr.

German-American Electric Company, New York, show a number of Grant flaming-arc lamps in operation and a complete line of Grant tungsten lamps, in addition to automatic hanging devices. The exhibit is in charge of Mr. Lambert Schmidt, who is assisted by Vice-President Whittlesey, and Messrs. R. Hanschke, Jr., F. E. Lande and E. J. Deuth.

Radio Reflector Company, New York, is demonstrating the merits of its reflector in the following manner: A number of carbon-filament lamps are shown without reflectors or shades in one cabinet. In another cabinet the same size and type of lamp is shown with Radio reflectors, thus demonstrating the increase in downward candle-power procured through the agency of the latter. A metal flash sign, containing 100 lamps, alternating with reflectors and without, is featured and the advantages of the reflector for lamps over machines of various kinds are pointed out. Mr. A. M. Hirshfield is in charge of the exhibit.

of "Ad-o-Scopes." The window ad-o-scope is 50 in. long, 41 in. wide and 15 in. high and weighs approximately 150 lb. By means of stereoscopic projections and colors a manufacturer may show to a consumer each step in the manufacture of an article, the purity of material, cleanliness in preparation and other points of interest. In addition it is possible to show 12 panoramic cards of the standard street-car style. The theater ad-o-scope is intended for showing living pictures of artists in colors illuminated from behind. The machine is 50 in. high, 42 in. wide and 18 in. deep, and by its use it is possible to show in panoramic photographs the portraits of the artists in the production and by the stereoscopic projections the complete play, scene by scene and act by act. The slides are turned by an electric motor and it is possible to insert new ones within a few minutes. Mr. W. Nephew King represents the company.

Moore Electrical Company, Newark, N. J., exhibits a yellow Moore light and a white Moore light. The former consists of



GENERAL VIEW OF EXHIBITS AT THE NEW YORK ELECTRICAL SHOW.

Empire Vacuum Company, New York, makes an exhibit of its "Imperial" vacuum cleaner. The general construction of the machine, with the various styles of cabinets containing the mechanism, are shown in connection with a full set of cleaning tools in different finishes, together with the styles of cord, hose and other appurtenances used with the equipment. Two handsomely finished cabinets are arranged for display purposes and practical demonstrations of alternating-current and direct-current machines are made. The company also exhibits a test motor and a pump showing the amount of vacuum obtained by this cleaner. This exhibit is intended primarily to demonstrate the efficiency of the suction and blowing device. Messrs. F. B. Cochrane and F. S. Bon represent the company.

Feature Advertising Company, New York, shows a number

a tube 162 ft. long, lighting the large main entrance corridor of the Garden. The exhibit of the white Moore light consists of an artificial daylight window about 2 ft. square. This is located in the booth of the United Electric Light & Power Company. The color from this window is claimed to be pure white and it is said to be the first light under which the quality of diamonds can be determined accurately. This form of Moore tube is especially novel because it is semi-portable. It operates on 220 volt, 60 cycle, alternating current, and is suitable for jewelry stores, silk and ribbon counters, dress goods departments of dry goods stores, and wherever true color values are of importance. The representatives of the company in attendance are Messrs. L. J. Auerbacher, James Bronis, W. P. Dickson, R. T. Trimble and C. D. Warner.

The Heany Lamp Company, New York, makes a display of Heany tungsten lamps, fireproof asbestos covered wire and tipless lamps, both of carbon and tungsten types, as manufactured by the Tipless Lamp Company. The Heany arc lamp manufactured by the Lord Electric Company is also accorded space in the company's booth. Mr. Arthur Starke is in charge of the company's interests at the show.

The Southern Exchange Company, New York, exhibits sections of its octagonal and square poles, cross-arms for telephone, electric light and transmission lines. The booth is tastefully decorated and enhanced by large pictures of the company's mills and yards in the south. The company makes a specialty of high-grade cross-arms, yellow pine octagonal and square poles and is the pioneer producer of the Southern wide cedar poles. Mr. E. G. Chamberlin is in charge of the exhibit.

Pelouze Electric Heater Company, Chicago, shows samples of its new 20-lb. tailor's goose. This iron is so constructed as to admit of three heats, adjustable while in operation. The low heat is arranged to keep the iron at proper working temperature while left standing. There is also on exhibition the "Universal" iron in three other sizes—4 lb., 6½ lb. and 9 lb. In this iron the temperature can be controlled by a simple movement of the hand while ironing. The iron has not only a hot point, but hot edges, and is so arranged as to give good distribution of heat on the bottom at all three contacts. Col. W. Pelouze and Mr. A. A. Guardia are representing the company.

Como Electrical Company, Spring Lake, New Jersey, manufacturer of the Hickley electrolytic alternating-current rectifier, has on exhibition a number of these devices. The largest type is intended for charging a 24-cell, vehicle battery, another type is intended for garage use in connection with six 6-volt batteries on a 110-volt, alternating-current line. Several smaller types suitable for charging batteries or for running small motors, such as are used in railroad signal work, are displayed. The company builds rectifiers to charge as many as 40 cells at 25 amp, also to operate searchlamps, x-ray apparatus, dental engines and lathes from alternating-current circuits. The rectifier, the manufacturer claims, will operate on any cycle from 10 to 133 and at any voltage up to 1000. The representatives at the Show include Mr. A. S. Hickley, Mr. Robert Boone and Mr. W. W. Rowan.

The Excello Arc-Lamp Company, New York, displays the various types of alternating-current and direct-current lamps manufactured by it, including alternating-current lamps for operation 4 in series on 220-volt circuits with enclosed compensating choke coil. A decorative brass-covered lamp with colored globe is on exhibition and a new quartz lamp is introduced as a novelty. The latter lamp is not being placed on the market by the Excello Company, but is exhibited merely to show recent developments in that style of lamp. In addition to the lamps shown in the company's booth the United Electric Light, Heat & Power Company has two alternating-current Excello flaming-arc lamps with reactive coils instead of resistances on exhibition, and there are eight Excello lamps used for the illumination of the Arcade at the Madison Avenue entrance of the Garden. Representatives of the company in attendance include Messrs. H. M. Hirshburg, R. F. Pierce, J. L. Dinsmoor and A. J. Thompson.

The Electric Home Supply Company, New York, specialist in selling electrical appliances for the home, is exhibiting goods made by the Vulcan Electric Heating Company, of Chicago, manufacturer of soldering and branding coppers, can-sealing device and the "electrocurl," which is an electrically heated curling-iron. The electric soldering coppers, as well as the electrocurl, are shown in operation. The company also exhibits the product of the Dielite Manufacturing Company, of Philadelphia, manufacturer of the "Dim-a-lite" regulating socket, Wirt regulating rheostats and dimmers, as well as the Dielite insulating joints. A full line of Pluto electric heating appliances is displayed. A feature of the exhibit is a 10-room, completely equipped and electrically lighted doll house and a case containing an electric cooking outfit intended for a child. The exhibit is supervised by Mr. Max Lowenthal, who is assisted by Mr. A H. Diamant, Mr. H. H. Russell, of the Vulcan Electric Heating Company; Mr. G. R. Hall, of the Dielite Manufacturing Company.

Sunray Electric Lamp Manufacturing Company, New York, has on exhibit a rack containing seven lamps, six of which show the progressive stages of the arc during the life of the electrode, demonstrating clearly the short arc travel and the small loss of light from deposit on the globe. An eighth lamp on the rack is said to have a life of 100 to 120 hours at a single trimming. The intention of the company is to trim this lamp at the opening of the exhibit and to permit it to burn 10 hours each day during the exhibition without retrimming. A table in the center of the booth is fitted with four lamps having various types of ornamental shades and fittings. On one side of the space is a small laboratory table with instruments for taking readings of the various lamps and a panel fitted with all the separate parts of the lamps is on exhibition. A high-voltage lamp for multiple connection on 220-240-volt circuits, which is built for 2 amp, 2½ amp and 3 amp, and is said to maintain a voltage of 150 at the arc, is also displayed. An attractive pamphlet, illustrating and describing the lamp and giving tests and useful information, is being distributed.

The General Electric Company's booth is located in the center part of the Garden to the left of the center aisle. Here is shown a complete line of heating apparatus, flaming arc lamps, intensified arc lamps and the company's multiple automatic cut-out and hanger for rope suspension. An interesting feature is a wire-braiding machine in operation, showing the method of making cord for heating devices. In the center of the booth are General Electric motors, operating Ingersoll-Rand drills and a Bridgeport Safety Wheel Company's grinder. A line of motors is also shown, not in operation, so as to admit of close inspection. In addition to the above there is displayed a complete line of fan motors, rheostats, circuit-breakers, meters, instruments, a multiple rectifier, a 10,000-volt lightning arrester and a complete line of automobile accessories. The General Electric Company also exhibits its complete line of tungsten and tantalum lamps, including the new 200-volt and 250-volt types. A circle of lamps surrounding the well-known G.E. monogram demonstrates the ability of the lamps to burn in any position. Included in the exhibit is a photometer, comparing a 32-cp, 110-watt carbon lamp with a 40-watt tungsten lamp, each lamp taking power through a testing wattmeter, thereby showing the different power consumptions for equal candle-power. Special attention is called to the comparison of quality of light illustrated by this apparatus The 4-cp, 5-watt tungsten sign lamps are shown in operation. and the striking white brilliancy is an attractive feature. A comparison board with a wattmeter shows that 10 tungsten sign lamps are equivalent to three carbon sign lamps in power consumption, but far superior in character and amount of illumination. Automobile lighting by tungsten lamps is given a prominent place in the exhibit, a model dashboard, with head-lamps. side-lamps and tail-lamps being shown. The tungsten head-lamp has a spiral filament of high intrinsic brilliancy, accurately located in the focus of a parabolic mirror, and gives an intense forward illumination fully equal to the ordinary acetylene headlamp. The outfit is operated by a 120-amp-hour storage battery and the convenient switching arrangement for controlling all the lamps independently from the dashboard is shown. The automobile lamps are made with sturdy filaments, to withstand the severest service. A very complete line of miniature and low-voltage tungstens is also exhibited. The company's tungsten street series lamps are shown on brackets, supported from the pillars of the booth. Numerous photographs of notable installations, using thousands of tungsten and tantalum lamps, give the public striking examples of the degree to which these lamps have superseded the carbon lamps. Among the representatives of the lamp works attending the show are Messrs. F. W. Willcox, G. C. Osborn, R. B. Parker, E. R. Sherwood, H. W. Jackson, C. M. Bunnell, W. C. Andrews and C. W. Bettcher.

New York Electrical School, New York, in its booth in the north gallery, makes a photographic display of the practical working conditions of its courses, samples of the work done by the students in electrical drafting, and a comprehensive description of the aims and purposes of the course given. The representatives who have charge of the exhibit are Messrs. John L. O'Conner, Geo. J. Cox and E. G. Grandstaff.

The Economical Electric Lamp Company, New York, manufacturer of turn-down lamps, has on exhibition the "Hylo" and "Economical" pull string, turn-bulb and long-distance lamps, and also the "Hylo-Economical" tungsten lamps. By means of automatic machines the large and small filaments of the lamps are switched in and out of circuit, so that the relative intensity of the light from each is shown. Messrs. L. and M. Lobenthal, assisted by several employees, are in attendance.

Collins Wireless Telephone Company, Newark, N. J., displays as leading features in its booth a variable tuning transformer, auto-transformer and rotating oscillation arc. These are the instruments which it is claimed were employed by Mr. Collins in talking from New York to Philadelphia without wires. The Collins transmitter is also on exhibition. This is a compact device made of brass, nickel and ebony. High-frequency and high-potential apparatus, induction coils and transformers for therapeutic, ignition and wireless work are shown. The booth is in charge of Mr. William White, assisted by Messrs. Sanchez and Copp.

Fox Bros. & Company, New York, are exhibiting their well-known "Polar" flaming-arc lamp, together with a complete line of miniature enclosed arc lamps and arc-lamp accessories. Included in the latter are Fox multiple and series contact couplings, positive safety winches, windlasses, etc. The company features what is said to be entirely new in the flaming-arc lamp field, a type of arc lamp known as the "Delta." These lamps burn with superposed electrodes, consisting of a thick core and a thick carbon surface, and electrodes are obtainable for white, yellow or golden light. A new type of "Radiante" lamp which is said to embody improvements in the miniature enclosed arc lamp line is on exhibition. The life on one trim of electrodes is claimed to be 100 hours and the lamp may be operated singly on 100 volts to 120 volts or in series on 200 volts to 240 volts, the power consumption being 440 watts. Messrs. H. L., H. C. and F. F. Fox, T. P. Gleeson, G. A. Nisbet, Mr. Batterman and Mr. Harris are in attendance.

General Vehicle Company, Long Island City, N. Y., shows one of its latest type 2000-lb. wagons complete. The truck is jacked up in such a manner as to permit the power plant to be operated. The wagon has ample floor loading space and is adapted to many lines of business. It is said to be capable of making 40 miles per charge of battery when loaded over half of its course so that it can meet the delivery requirements of almost all classes of business. The standard chasses are equipped with bodies of various shapes and designs to meet the requirements of purchasers. The battery comprises 44 9-plate cells arranged in four crates. An 85-volt General Electric motor is employed and Hess-Bright ball bearings are used to minimize friction. The countershaft is of the housed type on Timken roller bearings, and the first reduction of the transmission is by the Morse silent chain and the second reduction on roller side chains to each rear wheel. The exhibit is in charge of Mr. J. H. Vail, assisted by Mr. C. W. Squires, Jr.

F. L. Smidth & Company, New York, manufacturers of cement grinding machinery, show a "Lenix" drive which the company calls the paradox of an ordinary motor belt drive. Vertical superposed shafts are employed and the arc of contact between the belt and the large pulley is approximately 266 deg., and for the small pulley 200 deg. A brake is mounted on the driven shaft to show the action of the drive under load. At a glance the device looks like a belt tightener, but closer examination reveals the fact that it works on an entirely different principle. The Lenix roller has its bearings in a roller arm turning on the axis of a stand. The effect of the roller is two-fold; it not only increases the arc of contact between the belt and the pulleys, but also serves to regulate the tension in the belt. While the exhibit shows the pulley superposed, most of the installations made by the company have been for shafts placed in a horizontal plane or in an inclined plane, resulting in a considerable saving of floor space and the use of a large ratio of transmission without countershafts. The company is represented by the following: Messrs. Geo. M. Newcomer, H. W. L. Logan, E. Olsen, O. E. Morgensen and Thorkild Avnsoe.

The Westinghouse Electrical & Manufacturing Company's exhibit is representative of the complete line of small motors and electrical heating apparatus, intended for domestic use, manufactured by this company, omitting reference to its extensive and well-known products of electrical machinery for lighting, power and traction. Among the electrical heating devices are shown a toaster stove, steel-top hot plate, electric sad-irons, tailor irons and luminous and non-luminous radiators. A new automatic tailor iron is exhibited, which is arranged so that it heats only when it is placed on the stand, and, therefore, does away with the objection which the tailors have had—the trailing cord. The company has four demonstrators. One demonstrates the toaster stove and steel hot plate, toasting bread and cooking cereals, etc. Another demonstrates the family sewing-machine motor, one of which is connected with a sewing machine, where a regular seamstress is employed, making little garments, which, after the show, will be donated to one of the orphan asylums in New York. The family sad-irons are shown by a demonstrator who irons the garments which had been made by the seamstress. The tailor's iron is demonstrated by a tailor who brings in clothing from his shop and does the actual work of pressing the clothes at the exhibit. The booth is illuminated by festoons of low-voltage, 25-watt tungsten lamps with prismatic reflectors. Two large arches are lighted by tungsten lamps of different sizes from 25-watt to 250-watt, one arch showing the entire line for 110 volts, while the other arch shows the entire line of 220-volt lamps. The tungsten sign lamps, both the W type and the regular type, are displayed in large "W's," 18 in. high.

Roger Williams, New York, shows a very complete line of salable articles. The exhibit contains about 200 different devices and one of the latest on view is an electrical toaster which will toast four slices of bread in from 2½ to 3 minutes with a power consumption of 500 watts. This is claimed to be the most economical toaster on the market and is of the usual Simplex quality. There are also on exhibition a number of new devices, including a large nursery milk warmer, a hotel toaster, two styles of irons for heavy flat work, besides a complete line of household irons, laundry irons, tailor's irons, electric stoves, chafing dishes, water cups, curling-iron heaters, heating pads, percolators, dining-room outfits consisting of a chafing dish, coffee percolater and tea-kettle combination which is very popular with electrical companies, waffle irons, permitting waffles to be made on the dining-room table, and cooking utensils, such as blazers, double boilers, tea kettles and sauce pans, all arranged to clamp to the stoves, thereby making them more efficient and at the same time permitting them to be removed for cleansing. Among the other articles are electric ranges with a water heater, heating the water in the ordinary kitchen boiler. On these ranges no wires are exposed and no complications are involved. Glue pots, soldering coppers, regulator stands for the commercial irons and cord supports complete the exhibit. Mr. Roger Williams, the New York agent for the Simplex Electric Heating Company, is in charge of the exhibit, and he is assisted by Messrs. H. K. Stiles, C. O. Haggist, A. Hodgson and J. Ehler. From the Simplex Electric Heating Company there are present Messrs. J. I. Ayer, E. B. Stebbens and R. P. Ingalls. The company has loaned to the Dryer Manufacturing Company laundry irons with which to do ironing and electric heaters for the clothes dryers. In the New York Edison Company's exhibit the Simplex stoves for making candy and for baking shredded wheat, irons and numerous other articles are in evidence. The booth of the Edison Electric Company, Brooklyn, also has a complete line of samples, together with an oven made from plate glass so that biscuits and cake can be observed by the general public in the baking process.

National Electric Lamp Association has a booth facing the entrance to the Garden, where are displayed samples of the products of the various lamp companies in the association. The general scheme of decoration usually employed by the association at all exhibitions is followed out and sufficient room is allowed in the booth for entertaining visitors without encroaching on the exhibition space.

Duntley Manufacturing Company, Chicago, displays a number of pneumatic cleaners; a scrubbing machine for shampooing carpets and a small gasoline electric generator set capable of lighting eight lamps and giving the necessary electrical energy for operating the sweeping machines. Those in attendance include Messrs. G. R. Harms, P. G. Steigelman, N. Harms, L. E. Spurrell and M. Puessey.

J. Livingston & Company, New York, have on exhibition a "type B" portable suction sweeper. This machine embodies many improvements over the company's former type, and is made in three sizes, driven by ⅛-hp, ¼-hp and ½-hp motors respectively. The first two sizes can be operated by connecting them to any ordinary lamp socket, whereas the ½-hp size should have a special circuit. The work of the machine is said to be equal to that from a stationary plant, and its construction and design such that it is very easily handled. No tools are required for its ordinary use and much attention has been given to the design of the nozzles or the renovators. The exhibit is in charge of Mr. A. B. Cadley.

Murphy Electricity Rectifier Company, Rochester, N. Y., exhibits a rotary disk type of rectifier and also a stationary electrode type. The latter possesses an advantage over the former in being self-starting and in eliminating all moving parts with the exception of a small synchronous motor. It is, moreover, much smaller and simpler in construction. The principle under which the Murphy rectifier operates has already been described in our columns. The device is applicable to a large number of uses, including the charging of batteries for electric carriages, telephone, fire alarm systems and car lighting, also for moving picture machines, electroplating, x-ray work and other purposes where direct current is required and an alternating current source only available.

Electrical Testing Laboratories, New York, direct attention in their exhibit in the north gallery to three of the many and various classes of testing performed by them. The relative efficiencies and color values in modern electric illuminants are shown with the aid of specially constructed booths which conceal the lamps while displaying the characteristics of the light. The appearance of colored fabrics when illuminated by the lamps offers an interesting study of light quality. The relative brightness of screens illuminated by the lamps illustrates the strides which have recently been made in the efficiency of electric illuminants. An exhibit is made of a complete installation of a wire testing machine in operation, showing the Laboratories' method of making tensile, torsional and elasticity tests and the apparatus for testing the conductivity and insulation resistance. A few of the reference standards used by the Laboratories are also on view. Dr. Sharp and Mr. P. S. Millar are in attendance.

W. P. Pressinger Company, New York, general agent for the Keller Manufacturing Company of Philadelphia, exhibits in two adjoining sections a large number of "Santo" portable electric vacuum cleaners with full equipments; several special portable cleaners finished in different colors to show how the machine can be furnished when desired to meet architectural and personal wishes, and one transparent cleaner. In the latter machine the dust can be seen entering the bag and the full operation of the vacuum pump can be followed. There are also on exhibition truck type machines suitable for use in hotels, apartments, car-barns, railroad stations and places where a large and powerful machine is desired. In addition to its use as an exhibit the machine is employed by the show management for general cleaning throughout the exhibit. It is also at the service of the various exhibitors to be used by them for cleaning their exhibits. There are a number of attractive photographs showing portable and stationary machines in operation and various special tools intended for cleaning billiard tables and other apparatus. Representatives of the W. P. Pressinger Company distribute suitable circulars and pamphlets.

The Goulds Manufacturing Company, New York, features as its main exhibit a single acting triplex power plunger pump mounted on a bed plate with an adjustable belt idler and belt connected to a 220-volt, ¾-hp Crocker-Wheeler motor. The pump is fitted with a by-pass and relief valve arrangement so that in case a valve is shut or a stop occurs in the discharge line, the valve will open and allow the water from the pump to pass away without increasing the pressure. The pump is shown in operation, taking water from a tank beneath a table and discharging it into a glass aquarium. It is arranged to start and stop automatically by the rise and fall of water in the tank. The tank switch is mounted on a marble panel at the back of the outfit, and on this panel are mounted an ammeter, a pressure gage, knife switch and fuses. A valve on the discharge line permits the gage to record the pressure against which the pump is operating, while the ammeter shows the amount of current the pump is using. A number of pumps lying idle, together with framed photographs and sectional views of the pumps are on exhibition. Representing the company are Messrs. W. H. Hopper, W. E. Dickey, W. H. Valentine, E. E. Brereton and Jos. Burger.

Otis Elevator Company, New York, has a booth situated in the center of the Garden, where a working model of an Otis automatic push-button elevator is installed. In order to show the working and parts of this type of elevator a steel tower 30 ft. high is used. At the top of the four posts of this tower are large electric globes and underneath these enclosing the sheaves and governors are the words "Otis Elevator Company." The steel work and machine are painted in white with gold striping and the car is white enameled. Inside the car is placed the usual bank of buttons and connecting in series to this is a similar bank, because of the impossibility to see the working of the elevator when it is at the two upper floors. In order to show the operation of the car when called from any of the hall doors, the regular hall call buttons on the upper landings are connected with push buttons within convenient distance of the Garden floor. At the lower landing is a hall door and also a hall call button. The method of announcing at which floor the elevator car will stop is by means of an electric sign located at each of the three landings showing on all sides of the tower which reads "Car will automatically stop here." The safety device consists of an Otis roll safety switch placed at the top and bottom of the tower, limiting the travel of the car, and there is also the regular slack cable device. Besides the above safeties, use is made of a folding gate inside the car and also automatic of door locks. This is shown on the hall door at the bottom of the hatch and at the two upper floors. The motion of the car is visible because the doors are left out at the upper landings. By means of the last mentioned devices, the inability to operate the car until all the doors are closed is clearly shown. The elevator used is a regular Otis type "O" direct-current machine with full automatic controllers mounted on the bed plate to show the compactness of an elevator of this type in a private residence. Another feature of the exhibit is the official model of the Metropolitan Life Insurance Company Building, the model being 1/100 the actual size of the real structure. This building is the highest office structure in the world and contains in the tower six Otis traction elevators. A large electrically lighted colored photograph of the Singer Building, which is similarly equipped, is also on exhibition. In order to show the development of alternating-current apparatus the company has loaned to the United Electric Light and Power Company one of its latest worm-geared traction machines for basement installations. The apparatus consists of an Otis two-phase alternating-current slip-ring type of motor driving the traction sheaves through a worm and gear. An alternating current single-phase magnet controller and a magnetic brake also form parts of the exhibit.

SIBLEY & PITMAN, New York, have an exhibition of portable electroliers and pendants with arc glass shades, the product of the Amboy Works. Messrs. O. M. Dickson and W. H. Schleicher were in attendance.

INTERNATIONAL CORRESPONDENCE SCHOOLS, New York, show bound volumes of their various courses and specimens of students' work. The work of this institution is well known and needs no comment.

THE CRANE COMPANY, New York, shows electrically-operated gates and valves, cast-steel valves and headers and an operating exhibit of the "Cranetilt" steam traps. The company is represented by Mr. F. C. Sabin, of Chicago, who is in charge and who is assisted by Mr. W. L. Oswald.

ELECTRICAL WORLD has a booth on the main aisle, where current issues of the paper are being distributed and some of the standard McGraw publications are on exhibition. Representatives of the business, editorial and subscription departments are in constant attendance.

HOOVER SUCTION SWEEPER COMPANY, New Berlin, Ohio, shows a number of sweepers in operation. Those in attendance include Messrs. W. W. Steele, A. W. Wassing, L. Carter, E. B. Schlitz, H. W. Hoover, A. Strahs, R. M. Thomas and E. E. Martin.

THE GENERAL COMPRESSED AIR & VACUUM MACHINE COMPANY, St. Louis, exhibits through Mr. A. C. Smucker, its New York agent, a number of Thurman portable electric vacuum cleaners. These are shown in operation by Mr. Smucker and a number of assistants.

THE STORAGE BATTERY SUPPLY COMPANY, New York, is represented by Mr. T. D. Bunce. The feature of its exhibit is the Hudson-Fulton storage battery intended for Christmas tree outfits and similar uses. A hydrometer syringe, electrolyte tester and electric dome lamps complete the display.

STANLEY & PATTERSON, New York, feature in their booth the wireless battery system and the Faraday electric bell. The battery system consists of devices for connecting dry cells in circuit without the intervention of wires. Floor boxes and stage pockets are also on view. Messrs. F. Eastman and C. F. Draper are in attendance.

THE C. H. WHEELER MANUFACTURING COMPANY, Philadelphia, is displaying a "rotrex" vacuum pump and centrifugal circulating pump, and a suction, valveless, double-acting, high-vacuum pump. These devices were recently described in our columns and are familiar to our readers. Mr. W. H. Trump represents the company.

H. KRANTZ MANUFACTURING COMPANY, Brooklyn, N. Y., exhibits samples of panel boards, switches, connection strips, fool-proof push-button panels, standard post-office construction panel-boards, outlet boxes, marine fixtures, standard three-wire panels, etc. A complete set of the company's literature is distributed to interested parties by Messrs. H. Krantz, G. W. Eckerson and D. M. Anderson.

DEVEAU TELEPHONE MANUFACTURING COMPANY, New York, features various lines of telephone apparatus, including intercommunicating telephone systems, apartment house telephones, branch exchanges, mine telephones, parts of telephone apparatus, a Woodruff carriage call system, annunciators, alarms, etc. Messrs. C. Auth, A. S. DeVeau, J. Humphrey and A. H. Teale explain the merits of the various devices.

GUDEMAN & COMPANY, New York, electrical decorators, have a number of fruit trees, flowering plants, etc., on exhibition in which the fruit, flowers, etc., are represented by naturally shaped and colored lamps resembling the actual fruit or flowers, as the case may be. These are intended for dining-room and hotel use principally, forming attractive decorative features which add to the setting of tables, rooms, etc. Mr. Leo Gudeman is in charge.

AMERICAN ELECTRIC LAMP COMPANY, Philadelphia, displays a set of views showing the interior of its factory and the different parts at work. On each side of the space is a large case of lamps; one containing every type of tungsten and tantalum lamp and the other carbon metalized filament lamps. An exceptionally complete collection of miniature lamps all effectively displayed against a background of black velvet in illuminated cases is shown. The company is represented by Messrs. C. J. Purdy and LeRoy F. Johnston.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, shows one element of type H-131 Exide battery, such as is installed at the Sixteenth Street station of the New York Edison Company; nine standard sets of vehicle batteries as built for electric vehicle companies, Exide sparking duplex and emergency sparking batteries, car-lighting batteries, a two-cell unit for this service, automobile electric head lamps operated by Exide sparking batteries, and a casting mold electrically operated for casting souvenirs consisting of lead disks bearing the imprint of the company.

THE SHELTON ELECTRIC COMPANY, Chicago, shows a small hand hair-dryer which furnishes either hot or cold air by merely touching a button and which weighs 2¾ lb. Three kinds of vibratory massage machines designed for physicians. barbers and hairdressers and for home use are featured A new pedestal hair dryer which gives large volumes of hot or cold air, and takes all the weight from the hand, attracts no little attention. In the "Dragon" vibro-massage machine there is a piece to strap to the hand which transmits the vibration through the hand and also a regular massage handle for use in the regular way in barber shops. Those in attendance include Messrs. G. Shelton, J. Irwin, A. H. Wood and Mr. Crowley.

CHARLES L. KIEWERT COMPANY, New York, displays two "Aurola" lamps which give maximum distribution in a downward direction, two "Alba" vertical carbon lamps and one "Alba triplex," which is said to give about 4,000 cp with a difference of potential of 60 volts at the arc. At the back of the exhibition space is a show-window arranged to demonstrate the "Trucolor" lamp, particularly adapted to show-window use in connection with a prismatic hemispherical diffuser which equalizes and distributes the illumination in a most efficient manner. A line of Siemens carbons is shown. In addition to the display in the exhibit space there are eight Alba lamps on the tower of the Garden. Representing the company are Messrs. K. A. Albrecht, W. F. Hessel and S. Bernheim.

TUCKER ELECTRICAL CONSTRUCTION COMPANY, New York, features in its booth a 7-ft. model of the Manhattan Bridge across the East River as it appeared during the Hudson-Fulton celebration. The Tucker Company contracted for all the public work in the five boroughs and the bridge is illuminated by 350 11-volt, 2-cp lamps. On the back of the exhibition space are shown all the standard methods of wiring, including rigid conduit, flexible conduit, knob and tube, wooden moulding, metal moulding, fibrous conduit and combination systems, together with numerous devices used in household, tunnel, office, railway and marine work. The company is engaged in electrical contracting work only, and its booth has been arranged to feature this fact. Messrs. J. R. Strong, H. H. Sinclair and W. A. Cornell look after the interests of the concern.

THE WATSON-STILLMAN COMPANY, New York, has on exhibition twin volute turbine pumps direct-connected to motors and pumping water for house-tank purposes against a pressure of from 25 to 50 lb. A shaft straightener for straightening 4-in. steel rods, a hydraulic punch, a hydraulic jack, hydraulic motor lift and a 60-lb. hydraulic broaching press operated by a motor are featured. Those in attendance include Mr. H. A. Prindle, E. A. Stillman, J. B. Ketcham and Mr. Baker.

STUDEBAKER BROS. & COMPANY, New York, have three electric vehicles on exhibition in charge of Mr. F. B. Cutter. Side by side are a five-ton stake truck, the largest built by the company, and an 850-lb. panel wagon, the smallest vehicle turned out by the Studebaker concern. The latest model of victoria-phaeton forms the third exhibit. Exide batteries are used in series in connection with Westinghouse motors. The large truck has a two-motor equipment which gives an individual drive for each rear wheel and eliminates the necessity of a differential or equalizing gear. The delivery wagon is fitted with 26 cells of 11 M V Exide battery, but where long distance is required 44 cells of Edison A 6 are installed.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The past week in commercial trade was but a repetition of the favorable reports from all branches. The wholesale business is thoroughly satisfactory and orders are being received liberally from all sections of the country. Even the South, where it was feared the shortage of the cotton crop would curtail business, seems to be optimistic and ready to buy. The high prices being received for cotton, together with the unprecedentedly early movement of the crop to market, has given plenty of ready money to the Southern planters and this condition is immediately reflected in the retail trade. The buying is, however, marked by the same conservatism that has prevailed since the hard times of two years ago. In spite of the widespread sentiment of encouragement and the abounding faith in the future, there is no disposition to overplay the game. The number of idle cars has steadily diminished and in many special lines there is considerable shortage of cars. It is in the industrial lines, however, that the great record is being made. The production of pig iron for September broke all previous records. It was 6.1 per cent above that of August and 2 per cent ahead of October, 1907, the previous high record. The manufacturing plants in the iron industries are all busy and orders are piling up for future delivery at such a rate that the capacity of the mills will be taxed far into next year. Rail orders have been received in good volume and more are known to be ready for placement. Prices are being advanced all along the line, but this does not seem to put any check upon the demand. Building operations continue to be active and a long way ahead of the same periods last year. Collections are much improved owing to the liberal movement of the crops and business troubles are not numerous. Failures for the week ended Oct. 7, as reported by Bradstreet's, were 203, as against 195 the previous week, 256 in the same week of 1908, 192 in 1907, 192 in 1906 and 183 in 1905.

THE COPPER MARKET.

After having been weak and dull all during the week the copper market was almost demoralized on Oct. 11, by the publication of the figures of the Copper Producers' Association for September. These showed a record production and an increase in American stocks of 15,840,207 lb. The production record for September was 3,934,104 lb. per day, as against 3,890,233 lb. for August, the previous high record. The total production for the 30 days of the month was 118,023,139 lb.; the deliveries were, for domestic consumption 52,105,155 lb., for export 50,077,777 lb., a total of 102,182,932 lb. The situation in a nutshell is that the rate of production in September was the greatest ever known and the deliveries were less than for any month since February. The tone of the market was not improved, either by the additional knowledge that stocks in Europe had been accumulating heavily in warehouses and that many consumers, both here and abroad, held supplies vastly in excess of their immediate needs. The total stock of copper in American producers' hands on Oct. 1 is given as 151,472,772 lb. It is estimated that speculators alone are carrying in Europe 210,000,000 lb. The result of the publication of these figures was the immediate lowering of asking prices abroad and decided weakness in the local market. Sales were light, however, and consumers are evidently willing to wait for further concessions. Exports for the month, including Oct. 11, have amounted to 7879 tons. The daily call on the Metal Exchange at 12:30 o'clock, Oct. 11, quoted standard copper as shown in the table above.

NEW YORK METAL EXCHANGE PRICES.

	Bid.	Asked.	Settling price.
Spot	12.25	12.50	.....
October	12.25	12.40	12.32½
November	12.25	12.45	12.35
December	12.35	12.50	12.42½

The London prices Oct. 11 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	57 5 0	57 2 6
Standard copper, futures	58 5 0	58 2 6
Market	Weak	Easy
Sales of spot		1,000 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.37½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6

SIERRA & SAN FRANCISCO POWER COMPANY.—All of the negotiations have been concluded between the Stanislaus Electric Power Company and the Tuolumne Water Power Company and the new holding company known as the Sierra & San Francisco Power Company. The latter company is the concern incorporated recently to take over the properties of the Stanislaus and Tuolumne companies, which were purchased at foreclosure sale by interests identified with the United Railroads Company, of San Francisco. It is the intention of the new company to improve the water plants to the utmost extent. Energy will be transmitted 140 miles from the Stanislaus plant to San Francisco. This transmission will be at 100,000 volts, and in a substation just outside of San Francisco the voltage will be stepped down to 11,000. The secondary current will be distributed to four substations, where the alternating current of 11,000 volts, 60 cycles, will be transformed through motor-generator sets to 600 volts direct current. This is the energy that will be delivered to the railroad company. G. W. Bacon, of Ford, Bacon & Davis, is president of the company. J. E. Woodbridge is the engineer in charge on the Pacific Coast for Ford, Bacon & Davis.

WESTERN ELECTRIC COMPANY'S BUSINESS.—The Western Electric Company's business for September was very close to that of August, which was better than for any month during the year. It was 50 per cent better than September, 1908. This month ends the ten-month period of the company's fiscal year, and indicates that the total business for the year will probably amount to $47,000,000, which is an increase of 42.5 per cent over the gross business of 1908. The business of the company continues to be largely in small apparatus and in telephone appliances, but the expansion in the latter direction has been so great within the past six months that the company has been kept very busy. At the present time it is said that there are 17,000 workmen on the company's payroll, and this compares with 13,000 one year ago. The greatest number which the company ever employed was 29,000, in 1906. The business of the company has been growing especially in the territory west of the Mississippi River, and this has necessitated the increase of the facilities at the company's plant in Omaha, so that this establishment now handles electric lighting and other supplies in addition to telephone appliances.

MONEY TO LENGTHEN SUBWAY PLATFORMS.—The Board of Estimate and Apportionment appropriated last week $1,500,000 to pay for lengthening the station platforms of the New York City subway so as to accommodate ten-car expresses and eight-car local trains. It has been claimed by the Comptroller that although the Public Service Commission approved this improvement last spring, the Interborough company had never, until the past week, expressed its readiness to go on with the work. It is the opinion of Theodore P. Shonts, the president of the Interborough, that this improvement will add 25 per cent to the carrying capacity of the subway. It will require at least six months to complete the work.

BROOKLYN RAPID TRANSIT TRAFFIC.—John F. Calderwood, vice-president and general manager of the Brooklyn Rapid Transit Company, has given out a statement in which he said that the company carried 13,285,000 passengers between Sept. 25 and Oct. 2, inclusive. This was an average of 1,660,000 per day, and was far in excess of any traffic record made by the Brooklyn Rapid Transit Company.

MR. REISINGER ON GERMAN CONDITIONS.—Hugo Reisinger, the well-known importer of carbons, has returned from his annual trip to Germany. He says that general business conditions are improving in Germany, and, while they are much better than they were last year, he does not think that they are up to the mark of two years ago. While in Germany Mr. Reisinger spent a week at the carbon works of C. Conradty at Nuremberg, where the "Electra" carbons are manufactured. He fully discussed with the German manufacturers the new carbon situation created by the high rates of duty now imposed. Mr. Reisinger is of the opinion that the burden of the extra duty will have to be borne by the consumer, but that, nevertheless, he will be able to retain his full share of the business. He says that he will do this on account of the superior quality of the goods manufactured by his people, and on account of the additional fact that there are certain classes of goods which cannot be manufactured at all in this country, nor can they be manufactured in any other European country, their composition being an absolute secret possessed by the Conradty people. For the past year Mr. Reisinger has imported a carbon brush called "Bronskol," which was originally invented by a Swedish scientist, the patents of which for the world have been bought by Conradty. Mr. Reisinger claims that this "Bronskol" surpasses any carbon or metallic brush ever made, and that it has been adopted by all of the large electrical machinery manufacturers of the old world. While abroad Mr. Reisinger was honored by being received by the German Emperor and Empress of Germany, with whom he spent two hours.

BRITISH TUNGSTEN FILAMENTS FOR AMERICA.—F. Harrison, manager of the International Filament Company, Ltd., London, together with W. Stewart, financially interested in the enterprise, have been in this country for several weeks making contracts for the disposal of tungsten lamp filaments. These filaments are manufactured in England by a secret process controlled by Mr. Harrison, and are sold throughout Great Britain and on the continent by the Bryan Trading Syndicate of London. These gentlemen report that they have been quite successful in placing their filaments in this country, both with the independent manufacturers and with some members of the incandescent lamp combination. The same company also makes parts of lamps and has a patented sealed package for transporting tungsten lamps, so arranged that the lamp can be tested before the seal is broken, thus limiting claims to actual breakages in transit. Messrs. Harrison and Stewart have incorporated under the laws of New York a company, named the Electrical Manufacturers' Agency, for handling their goods in this country and which will have headquarters in New York. They also declare that if the market for their filaments turns out as satisfactory as it now promises, a factory will be established in this country in order to get the benefit of the 45 per cent tariff tax.

CENTRAL GEORGIA POWER COMPANY.—In a booklet recently issued, the first of a series, the Central Georgia Power Company advises the public of its plans which, in general, are to provide electrical energy in such a quantity and at such a cost as will make "Central Georgia one of the greatest industrial beehives on the American continent." The first hydroelectric plant will be on the upper waters of the Ocmulgee, near Jackson, Ga., where a dam 1700 ft. long is being constructed which will create a storage reservoir having an area of 6 square miles. In the power house, which will be integral with the dam, there will be six turbines direct connected to generators of 24,000 hp, with space for two additional units. When this and the other developments which the company's plan contemplates are completed, the company will have available a total of 150,000 hp.

ELECTRICAL BUSINESS EXPANDING.—The General Electric Company and the Westinghouse Electric & Manufacturing Company are now operating, according to a statement of an authority, at about 80 per cent of capacity. The present operation of these companies, it is said, is very close to what it was in 1907, but the manufacturing capacity has been greatly increased. The General Electric can now handle a gross business of $85,000,000 a year and the Westinghouse a business of $50,000,000. The relation between the two companies is said to be very much closer than it has ever been and it is intimated that there will not be a great amount of price cutting in the future.

TUNNELS UNDER THE EAST RIVER.—It is now given out with practically official authority that the tunnels under the East River from the Pennsylvania Railroad station in Manhattan to the railroad yards in Long Island City will be ready for operation by Jan. 1. This will probably also include the running of trains all the way to Jamaica. The north shore branch of this line will not be ready for operation before May. It is said that some time in the early fall of 1910 the entire electric zone of the Long Island Railroad Company will be in operation. The Pennsylvania Railroad Company does not expect to open its Hudson River tunnels until about the beginning of next summer.

DOMINION POWER & TRANSMISSION COMPANY.—It is announced that the Hamilton Cataract Power, Light & Traction Company is going to build a second transmission line to Brantford, a distance of 23 miles, the original line constructed in 1907 being already loaded up to its capacity. It is expected that the line will be built upon the right-of-way of the Brantford & Hamilton Railway, one of the allied concerns comprising the "Cataract" system now controlled by Dominion Power & Transmission Company. J. R. Moodie, president, and Wm. C. Hawkins, general manager, were in New York this week making the necessary financial arrangements.

NEW CORPORATION TAX LAW.—Haskins & Sells, certified public accountants, have issued a circular calling attention that the new corporation tax law, which became operative Aug. 5, prescribes methods of accounting for ascertaining net income which are at variance with the practices usually followed by industrial corporations and at variance with those prescribed for public service corporations by federal and State laws. The circular suggests that interpretations be secured as soon as possible from the Commissioner of Internal Revenue, so that accounting methods may be reconstructed before the end of the year and penalties avoided.

CLEVELAND STREET RAILWAY SITUATION.—Efforts have recently been made to arrange the final terms for the settlement of the Cleveland Street Railway difficulties. This situation has been an active fight for the past eight years. Under the new arrangement it is agreed that the city shall give to the Cleveland Railway Company, the owner of the lines, a 25-year franchise revokable at any time. The city of Cleveland is to reserve the right to purchase the lines at any time that municipal ownership is made lawful. The initial rate of fare is to be 3 cents on all lines, with a 1-cent extra charge for transfers.

ILLINOIS CENTRAL ELECTRIFICATION.—It is said that President Harahan, of the Illinois Central Railroad, will recommend at the company's annual meeting this month the immediate electrification of a two-track local suburban service from Randolph Street to Sixty-seventh Street. The company will buy the energy to operate this service and will probably use coke on other locomotives inside the city limits. The general electrification will be postponed for future consideration, but it is thought best to do something at once to appease public clamor.

GREAT NORTHERN DEVELOPMENT & LAND COMPANY.—All of the land on both sides of the Mississippi River from Anoka to Coon Creek Junction, in Minnesota, has been purchased by the Great Northern Development & Land Company, of Duluth. The company proposes to petition Congress for permission to erect a dam across Coon Creek which will cost $1,000,000. It is estimated that 50,000 hp can be developed, which will be transmitted upon high-tension lines to St. Paul and Minneapolis.

ROCKVILLE-WILLIMANTIC LIGHTING COMPANY.—The directors of the Rockville-Willimantic Lighting Company, of Willimantic, Conn., has adopted a new schedule of rates for energy. The new rates are on a sliding scale, and compared with present rates there will be a material reduction. It is stated that later on the company will adopt a new schedule for lighting. The company expects to connect the Willimantic system in the near future with South Windham and South Coventry.

GREAT WESTERN POWER COMPANY.—The Great Western Power Company, of California, has submitted a proposition to the City Council of San Francisco, offering to supply energy to operate the municipal electric light plant for ten years. This plan provides for the extension of the transmission line from Richmond to Alameda and would involve an expenditure of $10,000 by the city.

NORFOLK & WESTERN TELEPHONE SERVICE.—The Norfolk & Western Railroad has recently put into service two telephone circuits for handling its trains, one between Roanoke, Va., and Bluefield, W. Va., 102 miles, the other between Bluefield and Williamson, W. Va., 107 miles. There are 16 stations on the former circuit and 22 stations on the latter. Western Electric Company's telephone equipment and Gill selectors are used on both circuits. This equipment extends through some very mountainous country and affords a good test of telephone train dispatching under very severe conditions. It has been in service since Sept. 25, and W. C. Walstrum, superintendent of telegraph, reports that both circuits have been giving excellent service.

TO SEPARATE INTERESTS AT CHARLOTTE, N. C.—The Charlotte (N. C.) Consolidated Construction Company has applied to the Board of Aldermen of Charlotte for the right to separate its gas and lighting business from its traction business. It intends to form the Charlotte Gas & Electric Company, to take over these departments. The petition will probably be granted. The new company has been chartered for some months by E. D. Latta, president of the older company, and his associates. The company has numerous improvements in view. As to the separation of the traction interests from the electric light and gas interests, it is set forth by the company that such will greatly facilitate the issuance of bonds in the future.

LORD ELECTRIC COMPANY.—The Board of Water Supply of New York City has awarded to the Lord Electric Company the contract for furnishing two 12,500,000-gal. steam turbine pumps, two 225-hp tubular boilers and all accessories.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in the Wall Street stock market has been one of heavy liquidation and declining prices. The main reason for this condition has been the rapid advance in rates for money. After a year and a half of extremely easy money conditions, where the bankers were practically begging for borrowers, and rates were so low that any dividend paying stock could be carried at a profit, there has been a sudden tightening up, both in this country and abroad, which has checked the upward movement of stocks. The Bank of England has advanced its minimum discount rate to 3 per cent, and the German Imperial Bank is charging 5 per cent. Call money in New York during the week was as high as 6 per cent. Hundreds of loans were called and the bankers were showing considerable anxiety about maintaining their reserves. This necessarily caused heavy liquidation; many accounts cannot be carried when loans are called. During the week there has been especially heavy selling of the Harriman issues and of Steel common. The reason for the weakness in the Harriman stocks is partly because the stocks have been pushed to very high levels, and partly because there is uneasiness lest the Harriman holdings may be thrown on the market in the settlement of his estate. Steel common had made a perpendicular rise of almost 50 points, and had reached the high record of 94⅞. It has for more than a year been the most popular medium of speculation, and when money became high and good profits were in sight, it was only natural that unloading should become general. The condition of the steel industry is just as satisfactory as ever, but carrying stocks is not as easy. As it has been pointed out, the market has been on too high a level for the condition of business, and at the present time there is an equalization being made. Money rates on Oct. 11 were: Call, 4 @ 5 per cent; 90 days, 4¾ @ 5 per cent. The quotations in the table are those of the close Oct. 11.

NEW YORK.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
All.-Ch.	15⅝*	14¾*	900	Int.-Met., pfd.	49	47¼	25,400
All.-Ch., pfd..	54⅜	52	4,200	Mackay Cos..	93½	91	3,825
Amal. Cop....	83¾	79⅜	159,223	MackayCos.,p.	76½	75½	615
Am. D. T....	20½*	20½*	——	Man. Elev...	142	142*	865
Am. Loc.	61	58	5,700	Met. St. Ry.	20*	20*	——
Am. Loc., pfd.	115¾	115	100	N.Y.&N.J.Tel.	139¼*	139½*	——
Am. Tel. & Cbl.	85*	85*	——	Steel, com...	93⅞	86¼	2,070,320
Am. T. & T..	143⅜	141⅞	52,782	Steel, pfd...	130¼	126⅞	58,360
B. R. T.....	80⅞	77¾	25,265	W. U. T.....	78½	76¼	4,075
Gen. Elec.....	167	163	6,140	West'h. com..	87⅜	85⅜	5,200
Int.-Met., com.	16	15¼	16,310	West'h. pfd..	144	145*	700

PHILADELPHIA.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
Am. Rys.....	46	46*	——	Phila. Elec..	12½	12¾	——
Elec. Co. of A.	12¼	12¼*	——	Phila. R. T..	28¾	28	——
Elec. St. B'ty.	61	59½	——	Phila. Trac...	91	90	——
E. S. B'ty, pfd.	30*	30*	——	Union Trac..	53½	52½	——

CHICAGO.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
Chi. City Ry..	180*	180*	——	Chi. Tel. Co.	138*	137½*	——
Chi. Rs..Ser.1.	109¼*	109¼*	——	Met. El., com.	17¾*	17¾*	——
Chi. Rs..Ser.2.	36½*	36½*	——	Met. El., pfd.	51	52	——
Com. Edison..	120	121	——	Nat'l Carbon.	98¼	99¼	——
Chi. Sub'ws...	7⅞	5½	——	Nat'l C., pfd.	120*	120*	——

BOSTON.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
Am. T. & T...	143¼	142	——	Mex. Tel....	2⅜*	2¼*	——
Cum. Tel.....	140	142½	——	Mex. Tel.,pfd.	6½*	6½*	——
Edison E. Ill..	252*	252	——	N. E. Tel...	137	136¾*	——
Gen. Elec.....	167½*	162½	——	W. T. & T..	11¾	10	——
Mass. E. Ry..	18½*	17½*	——	W. T. & T., p.	88	89	——
Mass. E. R..p.	82*	80	——				

*Last price quoted.
Shares sold are for week of Oct. 4 to Oct. 9.

ASSOCIATED GAS & ELECTRIC COMPANY.—A controlling interest in the Associated Gas & Electric Company has been acquired by W. S. Barstow & Company, 50 Cedar Street, New York, with offices also in Portland, Ore. At the present time the Associated Gas & Electric Company has authorized $5,000,000 of collateral bonds, with stocks and bonds as collateral, of which there are $1,725,000 issued; $1,500,000 of debenture bonds, of which there are $225,000 issued; 6 per cent cumulative preferred stock authorized $1,000,000, of which there is $500,000 issued; common stock authorized, $1,000,000, of which $600,000 is issued. The properties to be taken over by W. S. Barstow & Company are as follows: Ithaca Electric Light & Power Company, Homer & Cortlandt Gas Light Company, Ithaca Gas Light Company, Norwich Gas & Electric Company, Hornell Gas Light Company, Canisteo Gas Light Company, Bethlehelm (Pa.) Consolidated Gas Company, Van Wert (Ohio) Gas Light Company, Greenville (Ohio) Gas Light Company, Delaware County (Pa.) Electric Company. The total securities of these companies are $1,950,000 stocks, $1,717,000 bonds. The officers of the Associated Gas & Electric Company, which will continue in existence and control the properties above mentioned, are: W. S. Barstow, president; William T. Morris, vice-president; O. Clement Swenson, treasurer; Jos. B. Taylor, secretary; T. W. Summers, general manager. The office hereafter will be at 50 Pine Street, New York, which is the headquarters of W. S. Barstow & Company. The properties, which formerly belonged to the Associated Gas & Electric Company, and which were disposed of outside of the present transfer, are: Lyons (N. Y.) Gas Light Company, Newark (N. Y.) Gas Light & Fuel Company, Oswego Gas Light Company, Palmyra Gas & Electric Company, Penn Yan Gas Light Company. These properties were not included in the sale to Barstow & Company and have been taken over by W. T. Morris, formerly president of the Associated company, who will manage them personally. The Delaware County Electric Company, which is mentioned above, is a consolidation of properties operating in Delaware County west of Philadelphia. The Associated Gas & Electric Company will own a large majority of the bonds and stocks of its subsidiary companies. W. S. Barstow is authority for the statement that there is plenty of money in sight under the new plan of financing to care for all of the extensive developments which are now contemplated in the subsidiary properties.

CHICAGO SUBWAY DIFFICULTIES.—When the stock of the Chicago Subway Company sold the other day at 4⅞ on continued heavy liquidation the representatives of the prinpal stockholders met in conference to consider the future of the property. It is said that the trouble with the company is that it has expended much larger sums in extensions than the development of traffic has warranted. A large part of this money was borrowed from E. H. Harriman and J. Ogden Armour on notes which are now falling due. This debt, it is said, amounts to about $14,000,000 and will require skilful refinancing.

LOS ANGELES GAS & ELECTRIC BONDS.—N. W. Harris & Company and E. H. Rollins & Sons report that the $1,000,000 5 per cent bonds of the Los Angeles Gas & Electric Corporation which they recently offered were all sold in one day and that a large number of bids were received which could not be filled. This is but one of many instances showing the growing popularity of the securities of public-service corporations.

AMERICAN POWER & LIGHT COMPANY.—There was incorporated last week under the laws of Delaware a new holding company to be known as the American Power & Light Company. The interests back of this concern are identical with those of the Electric Bond & Share Company, which, it is understood, belongs to the General Electric Company's interests. The new corporation will have a capital stock of $15,000,000, of which $5,000,000 is to be cumulative 6 per cent preferred. The immediate issue of stock will be $2,500,000 preferred and $5,500,000 common. The new company has already acquired the Home Light, Heat & Power Company, of Pittsburgh; the United Gas Company and the Edison Light & Power Company, of Wichita, Kan., and the Astoria Electric Company, of Astoria, Ore. In speaking of the organization of this new company, an official of the Electric Bond & Share Company said that the reason for it was that it was thought better to create a new company which could issue collateral bonds and new stock rather than to go through the necessary legal formulas for increasing the security issuing power of the Electric Bond & Share Company. All of the stock of the new company will belong to interests identical with the Electric Share & Bond Company.

CONTINENTAL TELEGRAPH & TELEPHONE COMPANY.—There was incorporated in New Jersey last week a company called the Continental Telegraph & Telephone Company, with an authorized capitalization of $50,000,000. The stock is equally divided between preferred and common. The purposes of the company, as announced, are to take over telephone lines in New York and New Jersey. The named incorporators are employes of the law firm of Philbin, Beekman & Menken, of New York, but at the office of that firm it was announced that at the present time no information concerning the new company could be given out. At the New York office of the American Telephone & Telegraph Company a positive denial was made that the new concern has anything to do with the Bell enterprises. It is understood that the company is to be a holding concern for numerous independent companies and it is intimated that it is allied with one of the big independents that has been endeavoring for some time to enter the field in New York City.

CONTEST FOR CONTROL OF WORCESTER COMPANY.—While the contest for control of the Worcester Electric Light Company is still being actively prosecuted there is no certainty as yet as to whether the Worcester interests or outside parties will win. This will not be determined until the result of the stockholders' meeting of Oct. 13 is made known. The protective committee, of which President Augustus B. R. Sprague is the chairman, announces in a circular which has just been issued to stockholders that it has secured control of enough stock to control the company. This committee has asked for deposits of stock in trust for 60 days and guarantees not to make any sale for less than $300 per share.

NORTHERN INDIANA GAS & ELECTRIC BONDS.—White & Company are offering $1,869,000 of 5 per cent bonds of the Northern Indiana Gas & Electric Company. These bonds are a portion of an authorized issue of $10,000,000. Of this authorized issue $1,756,500 are to be reserved to take up the bonds of the subsidiary companies and $6,434,500 is to be used for acquisitions and betterments at 85 per cent of cost. The company was formed last April by the consolidation of the South Shore & Electric Company, the Indian Harbor & East Chicago Electric Company and the Michigan City Gas & Electric Company. It is said that the company's earnings for the year will show a big advance over last year.

CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY, BALTIMORE.—The annual report of the Consolidated Gas, Electric Light & Power Company, of Baltimore, shows a net income in excess of operating expenses and taxes of $2,202,744. This is an increase over the previous year of $332,659. After providing for all fixed charges there was a balance of $828,197. This left a balance applicable to dividends of $828,197, which after paying the regular preferred dividend left an amount equal to 6.4 per cent on the common stock. The business of the company has been gradually growing, and the officials declare that the prospects for the coming year are exceedingly bright.

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.—The directors of the Kings County Electric Light & Power Company have recommended to the stockholders that they authorize an issue of $5,000,000 of convertible debenture bonds bearing 6 per cent interest. This will undoubtedly be done, and the proposition will be passed up to the Public Service Commission for authority. It is understood that extensive improvements in connection with the Edison Illuminating Company of Brooklyn are contemplated, and new money is required for this purpose. Up to this time the application for the bonds has not been filed with the Public Service Commission.

GRAND RAPIDS-MUSKEGON POWER COMPANY.—Proceedings have been started in the Supreme Court at Lansing, Mich., against the Grand Rapids-Muskegon Power Company, organized under the laws of Maine, to prevent it from exercising a franchise for the construction and operation of three dams along the Muskegon River, near Mecosta, Mich. It is alleged that the corporation has failed to comply with the terms of its franchise. The company has applied to the State Railway Commission for permission to issue $75,000,000 of gold bonds, which it is proposed to use as the demands of the property need.

HORNELL (N. Y.) TRACTION COMPANY.—A new corporation has been formed in the State of New York, known as the Hornell Traction Company, which will operate in Steuben County. The new company will take control of the Hornellsville Electric Railway Company, the Hornellsville & Canisteo Railway Company and the Canisteo Valley Electric Railway Company. The combined capital stock of these three companies is $120,000; the total capitalization of the new company is for the same amount, $120,000. The directors of the new company include Charles Adsit, George T. Rehn and Milo Macker.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—Recent publications concerning the stock ownership in the American Telephone & Telegraph Company show that outside of the Mackay Companies, of New York, there is really not any very large stockholder. Out of an issue of $200,000,000 there are but 32 stockholders who own as much as 5,000 shares each, and a number of these are brokerage houses which are probably carrying the stock for customers. It is said that there are 35,000 stockholders in all in the telephone company, but only 254 of these own as much as 1,000 shares.

CONNECTICUT VALLEY STREET RAILWAY BONDS.—The Railroad Commissioners of Massachusetts have approved the application of the Connecticut Valley Street Railway Company for permission to issue $700,000 of first mortgage bonds. Of the proceeds of the issue $500,000 is to be applied to the payment and refunding the issues of several companies which have consolidated with the Connecticut Valley company and the balance is to be devoted to taking up floating indebtedness and to improvements.

MICHIGAN WATER RIGHTS SECURED.—The Eastern Michigan Edison Company, of Detroit, has secured water rights along the Huron River which have heretofore been held by Frank I. Cornwell and John L. Duffy, of Ann Arbor. These rights give the company practically the entire water power of the Huron River from Lake Erie to Zuke Lake. The deal includes the transfer of the properties known as Dover's Dam, Hudson and Scio Dam.

PUBLIC UTILITIES IN QUEBEC.—It is said that a project is on foot for the consolidation of public utilities in Quebec. This involves the merging of the Quebec Railway & Light Company and the other lighting and power companies of the city. The details of the combination have not been worked out as yet, but the negotiations have been sufficient to advance the stock of the railway company from 57 to 68 in the past week.

NEW COLORADO ELECTRICAL ENTERPRISE.—Pueblo & San Luis Valley Railroad & Power Company has been incorporated in Colorado with a capital of $8,000,000 to construct an electric railway from Pueblo across the Sangre de Christo Mountains into the San Luis Valley. It is planned to build an interurban system among the towns in the valley. All along the route spur tracks will be run to the mining camps.

MIDDLESEX & BOSTON RAILWAY CONSOLIDATION.—The Railroad Commissioners of Massachusetts have approved the consolidation of the Middlesex & Boston Street Railway Company and the Newton & Boston Street Railway Company. They have also authorized the issue by the former company of $200,000 additional capital stock for the purpose of furthering the consolidation.

ASHEVILLE & EAST TENNESSEE RAILWAY.—At least $500,000 in bonds will be asked by the promoters of the Asheville & East Tennessee Railway, $200,000 from Buncombe County, $100,000 from Asheville and $200,000 from Mitchell and Yancey counties toward the completion of this projected electric highway from Weaverville to connect with the Carolina, Clinchfield & Ohio. The various counties and Asheville will hold elections if the proper petitions are presented to the authorities asking for the same, and several have already promised to call such elections if necessary. The proposed line would handle both freight and passengers. The Weaver Power Company has begun work on a new power plant near Marshall, on the French Broad River, where the river is bounded on either side by high mountains, making such a plant feasible. This company has an agreement with the Asheville & East Tennessee Company to supply energy at reasonable rates.

WHITNEY POWER COMPANY.—An announcement has been made that the Bankers' Trust Company of New York has taken an appeal from the decision of Judge J. C. Pritchard, in Federal court, in the case of the Whitney Power Company, in which is involved the question of the control of the $4,000,000 plant of the company on the Yadkin River. This appeal, it is said, will have the effect of stopping all work on the plant now nearing completion under the direction of the receiver, Col. W. S. Henderson.

CHATTAHOOCHEE POWER COMPANY.—Application has been filed for a charter for the Chattahoochee Power Company, of Columbus, Ga. The authorized capital stock is $2,000,000, and the incorporators are: B. H. Hardaway, George A. Pearce and P. J. Rankin, of Columbus. The company has acquired 7 miles of water front on the Chattahoochee River, in Harris County, and proposes to construct a dam 30 ft. high, where it is expected to develop 4000 hp. This will be transmitted to Columbus, a distance of 17 miles.

WESTINGHOUSE AIR BRAKE COMPANY.—The net earnings of the Westinghouse Air Brake Company for the fiscal year which ended July 31, 1909, show a gain of $14,517 over the previous year. While this gain is not large, and while the gross returns are a trifle less than for the year previous, the condition of the company is thought to be distinctly improved. The surplus for the year was within a few thousand dollars of that of the year previous.

SOUTHERN POWER COMPANY FRANCHISES.—Following in the wake of the action of the City Council of Columbia, S. C., in refusing the Southern Power Company certain franchises it is reported that at the next meeting of the South Carolina Legislature action may be taken to restrict the company's operations or to regulate it in accordance with the State's laws under the heading of so-called "anti-trust" legislation.

TELEPHONE ABSORPTION ENJOINED.—The Iowa courts have enjoined the Iowa Telephone Company, a Bell concern, from absorbing the Mutual Telephone Company of Des Moines. The latter company is an independent and the action was brought on a minority stockholders' petition. The Bell company recently secured the majority of the stock of the Mutual company.

NASSAU LIGHT & POWER COMPANY.—The Nassau Light & Power Company, of Mineola and Roslyn, Long Island, has been granted permission by the Public Service Commission of the Second District to absorb the Nassau Gas, Heat & Power Company, Floral Park Light & Power Company and the Oyster Bay Electric Light & Power Company.

DETROIT UNITED RAILWAY BONDS.—The Michigan Railway Commission has been asked by the Detroit United Railway Company for permission to issue $2,000,000 additional 5 per cent bonds. These bonds will be issued in January, 1910, and the proceeds will be used to take up a similar amount of collateral trust notes which will fall due Feb. 15, 1910.

DIVIDENDS.

American Light & Traction Company, preferred, quarterly, 1½ per cent, payable Nov. 1; common, quarterly, 2 per cent, payable Nov. 1; extra on common, 2½ per cent, payable Nov. 15.

Brooklyn City Railroad Company, quarterly, 2½ per cent, payable Oct. 15.

Cape Breton Electric Company, preferred, semi-annual, 3 per cent, payable Nov. 1.

Colorado Telephone Company, quarterly, 1¾ per cent, payable Oct. 15.

Edison Electric Illuminating Company, Boston, quarterly, 2½ per cent, payable Nov. 1.

Electric Securities Corporation, preferred, 2½ per cent, payable Nov. 1.

Guanajuato Power & Electric Company, preferred, quarterly, payable Nov. 1.

Holyoke (Mass.) Water Power Company, quarterly, 3 per cent, extra, 20 per cent, payable Oct. 5.

International Steam Pump Company, quarterly, 1½ per cent, payable Nov. 1.

Mexican Telephone & Telegraph Company, preferred, semi-annual, 2½ per cent, payable Nov. 1.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

Montreal Street Railway Company, quarterly, 2½ per cent, payable Nov. 2.

National Carbon Company, quarterly, 1¾ per cent, payable Oct. 15.

Nebraska Telephone Company, quarterly, 1½ per cent, payable Oct. 10.

Ottumwa (Ia.) Railway & Light Company, preferred, quarterly, 1¾ per cent, payable Oct. 15.

Pioneer Telephone & Telegraph Company, of Oklahoma, quarterly, 1¾ per cent, payable Sept. 30.

Twin City Electric Railway Company, quarterly, 1¼ per cent, payable Nov. 15.

J. G. White & Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings	Charges.	Surplus.
Blackstone Valley Gas & Electric Company:					
August, 1909	$74,404	$40,070	$34,334	$24,102	$10,232
August, 1908	68,340	34,967	33,373	.....	.....
Commonwealth Power Company, Jackson, Mich.:					
Year ended August, 31, 1909	583,090	283,735	299,356	145,323	154,033
Year ended August 31, 1908	536,815	259,420	277,395	139,745	137,649
Dallas (Tex.) Electric Corporation:					
August, 1909	128,749	88,218	40,531	28,648	11,883
August, 1908	94,738	63,553	31,185	28,329	2,856
Duluth-Superior Traction Company:					
August, 1909	92,235	53,650	38,585	18,416	20,169
August, 1908	84,733	46,109	38,624	18,916	19,708
Galveston-Houston Electric Company:					
August, 1909	111,294	62,976	48,318	21,679	26,639
August, 1908	101,707	55,100	46,607	20,527	26,080
Granby Consolidated Mining, Smelting & Power Company:					
Year ended June 30, 1909	3,983,536	3,470,029	513,507	270,000	243,507
Year ended June 30, 1908	3,790,184	3,435,760	354,424	675,000	320,576
International Railway Company, Buffalo:					
Year ended June 30, 1909	4,093,912	2,409 933	1,805,593	962,645	842,948
Year ended June 30, 1908	4,522,924	2,698,778	2,008,675	996,573	1,012,102
Minneapolis General Electric Company:					
August, 1909	77,508	36.896	40,612	30,028	10,584
August, 1908	74,411	34,414	39.997	32,091	7,906
Portland (Me.) Electric Company:					
August, 1909	25,503	10,640	14,863	.....	.....
August, 1908	22,539	9,045	13,494	.....	.....
Seattle Electric Company:					
August, 1909	610,815	312,119	298,696	108,787	190,109
August, 1908	382,741	219,659	163,082	94,834	68,248
Twin City Rapid Transit Company:					
August, 1909	641,062	262,479	378,582	140,250	238,332
August, 1908	592,702	281,707	310,995	128,667	182,328
Westinghouse Air Brake Company:					
Year ended July 31, 1909	5,286,021	3,246,748	2,039,273	118,715	1,920,557
Year ended July 31, 1908	5,308,016	3,298,260	2,014,756	43,960	1,970,796

GENERAL NEWS

Construction News.

BESSEMER, ALA.—It is reported that the Bessemer Gas Company will soon apply to the City Council for a franchise to operate an electric light plant in Bessemer.

GLOBE, ARIZ.—It is reported that the Arizona & Michigan Mining Company is planning to install a new steam-driven electric unit in its plant.

GLOBE, ARIZ.—Preparations are being made by the Arizona & Eastern Consolidated Mining Company for the construction of a hydroelectric plant to furnish electricity for operating its properties.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company is receiving electricity for operating its system in Phoenix, from the hydro-electric power plant at the Roosevelt Storage dam, 80 miles distant. The Pacific company is the first to receive service from the plant, but later electricity will be furnished to settlers removed from the ditches, who will irrigate the land by pumping plants, power being furnished in lieu of water for acreage interests in the reservoir.

MAMMOTH SPRING, ARK.—It is reported that Frank F. Hill, of Memphis, Tenn., and associates are interested in a project to construct a hydroelectric plant to transmit electricity to Mammoth Spring and Jonesboro, Ark.; West Plains, Mo., and other cities, at a cost of about $300,000.

ALAMEDA, CAL.—The Great Western Power Company, of San Francisco, Cal., has submitted a proposition to the City Council offering to supply electricity to operate the municipal electric light plant for a term of ten years. The plan provides for the extension of the transmission line of the company from Richmond to Alameda, which would involve an expenditure of $10,000, to be paid by the city. It is not expected that the offer will be accepted.

BEAUMONT, CAL.—The question of installing a street lighting system in Beaumont is under consideration.

CHICO, CAL.—Application has been made to the City Trustees by Guy R. Kennedy, representing the Sacramento Valley Power Company, for a franchise for the construction of a lighting, heating and power distributing plant in Chico. The company is reported to have plants located on Snow and Cow Creeks in Shasta County capable of developing 16,000 hp. It is proposed to erect an extension of its transmission line to Chico by the way of Anderson and Red Bluff.

LONG BEACH, CAL.—The City Council is considering the question of extending the street lighting system along Ocean Avenue for at least two miles and installing additional lamps to the pier and American Avenue.

LOS ANGELES, CAL.—The Board of Public Works is now in a position to appoint a consulting board of three engineers to have charge of plans for electrical power development along the line of the Los Angeles aqueduct.

LOS ANGELES, CAL.—The Sunnyslope Land Company has commenced work on the construction of an electric power plant, the cost of which is estimated at $50,000. George H. Ennis, of Los Angeles, Cal., is president of the company.

REDDING, CAL.—The Sacramento Valley Power Company will extend its transmission lines to Red Bluff and Chico, construction work now being under way. The company is a consolidation of the Northern Light & Power Company and the Shasta Power Company, each of which had an overhead distributing system covering the City of Redding. The Sacramento Valley Power Company is now taking down the Shasta Power Company's transmission system in Red Bluff. The Northern Light & Power Company's poles are allowed to remain because they carry the wires of the city fire alarm system. In those parts of Redding where the Sacramento Valley Power Company has only one line of poles they will be allowed to remain. The company has already applied for a franchise in Chico. The trustees of that city have taken favorable action, and bids for the sale of a franchise will be opened Nov. 2.

SACRAMENTO, CAL.—The Great Western Power Company has its transmission line almost completed from the Brighton plant to the city line at Sacramento, and connection with the city distributing point will be effected very soon. The Brighton substation has an output of 12,000 hp, which can be increased as required to 20,000.

SACRAMENTO, CAL.—After seven years of litigation over the control of the water of the American River at Folsom Prison, the State of California, through its prison board, and the Sacramento Electric, Gas & Railway Company, have reached a compromise. The power company is to have control of the waters as before they were restrained, but must stop or commence the flow upon written request of the prison board when it is shown desirable to State interests. The State won the suit, but found that in dry seasons by not damming the river there was not sufficient flow to give the prison even lights.

SAN BERNARDINO, CAL.—The County Board of Supervisors has passed a resolution directing an advertisement for the sale of a franchise for overhead transmission lines over various highways in the county applied for by the Southern California Edison Company, the new company into which the large companies of Southern California were recently merged. Bids for the sale of the franchise will be opened on Nov. 2. The resolution provides that the company is to pay the county 20 per cent. of the gross earnings after the first five years. The application was filed by Attorney Frank B. Daley.

SAN DIEGO, CAL.—G. W. Pursell, general manager of the San Diego, El Cajon & Escondido Electric Railway, has purchased the franchise sold by the City Council granting the company permission to enter San Diego for $5,100.

STOCKTON, CAL.—It is announced locally that the Santa Fé Railroad will at once equip all of its cabooses used in connection with freight trains with telephone instruments for the purpose of giving better protection from accidents. A portion of each caboose will be cut off and the necessary equipment for making connections with any of the offices along the line of the system will be installed.

YUBA CITY, CAL.—The Pacific Gas & Electric Company is securing rights of way for a transmission line from Yuba City to Sutter City and Meriden along the route of the survey for the proposed extension of the Northern Electric Railway from Yuba City to Colusa.

BRUSH, COL.—The Brush Electric Light & Power Company has just completed a power station to supply the Town of Brush, Col., with electricity for lamps and motors.

FLORENCE, COL.—The Arkansas River Power Company has filed maps and plans for the flume and ditch it proposes to construct between Salida and Florence. The ditch is to be 6 ft. deep, 36 ft. wide at the top, 24 ft. at the bottom and 45 miles long. The cost is estimated at $2,500,000. The company will supply power for all uses from four power houses, one at the mouth of Texas Creek, one at Howard, one at Coaldale and one at Parkvale. The incorporators are F. M. Tomlinson, Peter O'Brien and E. F. Hiatt.

MANCOS, COL.—The Mancos Electric Light & Power Company has just completed a new electric light plant in Mancos. The company will furnish lighting and power service.

PITKIN, COL.—A. E. Reynolds, manager of the Gold Links tunnel. mines and mill, it is reported, will install a hydroelectric plant.

WATERBURY, CONN.—It is reported that the Connecticut Company is planning to construct a new power house in Waterbury. The initial equipment will have a rating of 3000 hp, which it is planned to duplicate later. It is stated that Bigelow boilers will be installed.

WILLIMANTIC, CONN.—The directors of the Rockville-Willimantic Lighting Company have adopted a new schedule of rates for electricity for motors in Willimantic, Rockville, Stafford Springs and other places where the company furnishes electrical service. The new rates are on a sliding schedule and compared with the present rates there will be a material reduction. Later the company will adopt a new schedule of rates for electricity for lamps. The company expects to connect the Willimantic system with the new high-tension line within a month and is also planning to extend its electric lighting service to South Windham and South Coventry in the near future.

FORT DUPONT, DELAWARE CITY, DEL.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Dupont, Delaware City, Del., until Nov. 9 for the construction of an electric lighting system (no machinery required) at Fort Dupont. Plans and specifications can be seen at the above office and also at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $5 will be required on each set of plans loaned, which will be returned on return of same.

WILMINGTON, DEL.—No proposals were submitted to the Street and Sewer Directors for lighting the streets of the city in response to their call for bids, which were to be opened Oct. 5. The contract for street lighting with the Wilmington City Electric Company expires April 1, 1910.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 19, to furnish at the navy yards and naval stations the following supplies: Portsmouth, N. H.; Boston, Mass.; Brooklyn, N. Y.; Philadelphia, Pa., and Mare Island, Cal. Schedule 1711—Water tight bells and buzzers. Portsmouth, N. H., and Philadelphia, Pa. Schedule 1711—Non-water tight bells and buzzers. Boston, Mass.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Testing generators. Portsmouth, N. H., and Brooklyn, N. Y. Schedule 1711—Dynamotors. Portsmouth, N. H.; Philadelphia, Pa., and Brooklyn, N. Y. Schedule 1711—Night signal set keyboards. Brooklyn, N. Y.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Reserve type dry cells and lighting fixtures. Portsmouth, N. H.; Boston, Mass.; Brooklyn, N. Y.; Philalelphia, Pa.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Fuses and fuse wire. Boston, Mass.; Brooklyn, N. Y.; Philadelphia, Pa.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Wiring appliances. Philadelphia, Pa. Schedule 1711—41 Cut-out switches. Mare Island, Cal., and Brooklyn, N. Y. Schedule 1711—Knife switches and switches. Brooklyn, N. Y.; Philadelphia, Pa.;

Norfolk, Va., and Mare Island, Cal. Schedule 1711—Water tight boxes and terminals tubes. Portsmouth, N. H.; Boston, Mass.; Philadelphia, Pa.; Norfolk, Va.; Mare Island, Cal., and Brooklyn, N. Y. Schedule 1711—Electric fittings. Boston, Mass.; Philadelphia, Pa.; Norfolk, Va.; Mare Island, Cal., and Brooklyn, N. Y. Schedule 1711—Connection boxes and interior fittings. Boston, Mass., and Philadelphia, Pa. Schedule 1711—Water tight attachment plugs. Pensacola, Fla. Schedule 1750—16,600 lb. sheathing copper, etc. Mare Island, Cal., or Brooklyn, N. Y. Schedule 1725—22,000 ft. copper wire, insulators, clamps, etc. Applications for proposals should designate the schedule desired by number.

AUGUSTA, GA.—The City Council has granted a franchise to the Georgia-Carolina Power Company to do business in this city. It is said that work will soon commence on construction of a dam, which, it is expected, will develop about 10,000 hp.

COLUMBUS, GA.—Application has been filed for a charter for the Chattahoochee Power Company with a minimum capital of $100,000 and a maximum capital stock of $2,000,000. The incorporators are: B. H. Hardaway, George A. Pearce, E. J. Rankin and others, of Columbus, Ga. The company has acquired seven miles of water front on the Chattahoochee River in Harris County and proposes to construct a dam 30 ft. high where 4,000 hp will be developed, which will be transmitted by electricity to Columbus, a distance of 17 miles. The cost of the dam, power house and transmission lines is estimated at $400,000.

MACON, GA.—The Macon Traction Company has been granted a 50-year franchise by the County Commissioners to construct an electric railway from East Macon to Recreation Club, a distance of five miles. Frederick Kauffmann is said to be interested in the company.

SAVANNAH, GA.—The Twin City Power Company, which is constructing a dam above Augusta, has applied to the City Council for a franchise to supply electricity in Savannah. The company, it is said, proposes to develop about 50,000 hp.

WAYCROSS, GA.—Burdette Loomis, of Hartford, Conn., it is said, has again applied to the City Council for a franchise to furnish electricity in Waycross.

AURORA, ILL.—Plans are being prepared for improvements to the municipal electric light plant which will include the installation of new machinery and a thorough overhauling of the transmission system.

CHAMPAIGN, ILL.—The Illinois Traction Company has been granted a 25-year franchise by the City Council to extend its electric railway system in Champaign, under the terms of which the company is to pay the city $10,000.

HARRISTOWN, ILL.—It is reported that the Illinois Traction System, of Champaign, Ill., is contemplating the erection of a substation in Harristown.

MOLINE, ILL.—The Tri-City Railway & Light Company is contemplating the construction of a new gas plant in Moline next spring at a cost of about $500,000. J. F. Porter is president..

MONMOUTH, ILL.—The Western Stoneware Company is reported to have under consideration a number of improvements to its various plants, which will include substituting electricity for steam power in plants 1 and 2 in Monmouth, Ill.

RICHMOND, ILL.—The capital stock of the Spring Grove Telephone Company has been increased from $10,000 to $20,000, and its name changed to McHenry County Independent Telephone Company.

BEDFORD, IND.—The City Council has granted a franchise to the Bedford Power Company, which is building a dam across White River, at Williams, to furnish electricity for lamps and motors in Bedford.

MARION, IND.—The Indiana Auto Parts Company, recently organized, is planning to equip a plant for the manufacture of motor car specialties. Motor-driven equipment is contemplated.

SULLIVAN, IND.—The Sullivan Independent Telephone Company has purchased and taken over the plant and holdings in this city and county owned by the Central Union Telephone Company. The consideration was $100,000.

COLO, IA.—The Colo Lighting Company, recently organized, has purchased the Carver lighting plant. It is said that the company will make improvements to the plant and light the village. J. E. Morrell is president of the company and John Niland secretary and treasurer.

GRAND JUNCTION, IA.—The local electric light plant, owned by Ole Sweden, has been purchased by Wellington Jackson, of Newton, Ia.

POCAHONTAS, IA.—The question of establishing an electric light plant in Pocahontas is under consideration.

WELLSBURG, IA.—The construction of an electric light plant in Wellsburg is under consideration.

NICKERSON, KAN.—The question of issuing $35,000 in bonds for the construction of an electric light and water works plant is under consideration, and which, it is said, will be submitted to a vote.

GLASGOW, KY.—The Burren County fiscal court has granted a franchise to Charles Van-Den-Bergh to construct an electric railway through Burren County to Hart County. The railway will extend from Glasgow to Horse Cave, a distance of 18 miles.

LOUISVILLE, KY.—Plans are being made by the Kentucky Electric Company for extensive improvements and additions to its plant, which will involve an expenditure of about $400,000. The work will include the construction of a tunnel under Water Street and wharf, between Second Street and Third Avenue to the river for condensing water, railroad switches, coal and ash handling systems, etc. The output of the station is to be increased to 14,000 kw. Contract has been awarded for additional turbo-generator sets and boilers. Bids will soon be received for construction of tunnels to the river.

CLINTON, LA.—At an election held recently the citizens are reported to have voted to issue $15,000 in bonds, the proceeds to be used to establish a municipal electric light plant.

WEST POWNAL, MAINE.—Bids will be received by the Board of Trustees, Main School for Feeble Minded, West Pownal, Me., until Oct. 28 for furnishing material and labor for the construction of a power station for the Maine School for Feeble Minded. Plans and specifications for the building may be seen at the office of Coombs & Gibbs, architects, Lewiston, Me. Plans for the boilers, pumps, engines, etc., may be seen at the office of Arthur B. Fels, engineer, Portland, Me.

BOSTON, MASS.—The State Board of Railroad Commissioners has approved of an issue of bonds by the Connecticut Valley Street Railway Company not to exceed $700,000, of the proceeds, $500,000 is to be used for payment and refunding of bonds of several street railways, which have consolidated with the Connecticut Valley Company, the balance to be used for payment of floating indebtedness and improvements to the railways.

SALEM, MASS.—Announcement has been made by the Salem Electric Light Company of a reduction in commercial rates for electricity from 15 cents to 13 cents per kw-hour for incandescent lamps.

ANN ARBOR, MICH.—A deal has been closed whereby the Eastern Michigan Edison Company, of Detroit, Mich., has secured water rights along the Huron River held by Frank I. Cornwell and John L. Duffy, of Ann Arbor, Mich., which gives the company practically the entire water power of the Huron River from Lake Erie to Zuke Lakes. The deal includes the transfer of the property known as Dovers dam, Hudson and Scio dams and all flowage rights in connection with the dams. The Edison company is now dredging out the tail race and raising the dam whereby it will double its present power.

DETROIT, MICH.—The Gould Storage Battery Company, of Depew, N. Y., has been awarded the contract for furnishing and installing the regulating battery equipment for the electrical operation of the Detroit River tunnel at Detroit by the Michigan Central Railroad Company. The plant to be installed will have a rating of 1500 kw hour, which later will be increased to 2500 kw hour.

FLINT, MICH.—The Hirsch-Wesson Manufacturing Company, recently organized, is contemplating erecting a plant in Flint, Mich., and will require power equipment and light tools.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company has applied to the State Railway Commission for permission to issue $75,000,000 in bonds for the purpose of developing its property. George L. Erwin is secretary of the company.

MUSKEGON, MICH.—It is reported that the Interurban Electric Light & Power Company has purchased the uncompleted dam site on the Pere Marquette River, owned by a syndicate of business men of Hart. The syndicate is said to have expended more than $7,000 in partial development of the water power. The price paid for the property by the Interurban Electric Light & Power Company is said to be $10,000. The present plans of the company provide for the construction of a concrete dam and the erection of a transmission line reaching all the Oceana County villages.

NEGAUNEE, MICH.—Plans have been prepared by the Cleveland Cliffs Iron Company for the construction of a new hydraulic plant, which will include the construction of dam and flume and the installation of water turbines, etc.

PONTIAC, MICH.—The Rapid Motor Vehicle Company is making arrangements for installing an electric generating plant aggregating 1500 hp with Corliss engine drive, with auxiliary equipment for complete power service.

DULUTH, MINN.—The Great Northern Development & Land Company, of Duluth, Minn., has purchased all the land on both sides of the Mississippi River from Anoka to Coon Creek Junction. The company proposes, it is said, to petition Congress for permission to erect a dam across Coon Creek to be utilized for power purposes. The cost of the dam will be about $1,000,000 and it is estimated that 50,000 hp can be developed, which will be transmitted by electricity to St. Paul, Minneapolis and surrounding country for lamps, heat and motors.

LE SUEUR, MINN.—The city has awarded the contract for a Corliss heavy duty engine, 16 in. x 36 in., to drive an alternating-current generator (bids for which were opened Oct. 1) to the Bates Machine Company, of Joliet, Ill., for $2,398. James A. Morgan is city clerk.

MANKATO, MINN.—It is reported that the proposition to establish a municipal electric light plant will be submitted to the voters.

OLIVIA, MINN.—Arrangements are being made by the local telephone company to install the common battery system. The company, which was incorporated as the Bird Island Telephone Company, will change its name to the Renville County Telephone Company. It is expected that the company will erect a number of rural lines.

ST. PAUL, MINN.—The St. Paul Gas Light Company is contemplating increasing the output of its electric generating plant and will install new machinery to cost about $50,000.

WHITE BEAR, MINN.—H. M. Byllesby & Company, of Chicago, Ill., are reported to have taken an option on the plant of the White Bear

Electric Company, which is owned by the Fulton estate and George Reif. It is said that the Byllesby company will exercise its option and will take possession of the plant Nov. 1. The new owners, it is understood, will make many improvements to the plant and will install hydroelectric power, which will be secured from the large power plant on Apple River, Wis.

ACKERMAN, MISS.—At an election held recently the citizens voted to issue bonds for the construction of an electric light plant.

KING CITY, MO.—The question of installing an electric lighting system in King City is under consideration.

MEXICO, MO.—The Mexico, Santa Fé & Perry Traction Company, of Mexico, Mo., has awarded general contract for construction of its interurban railway to Burns & Co., 705 Isabella Building, Chicago, Ill. The railway is to extend south from Mexico to Columbia and Fulton, and north to Santa Fé, Perry and Hannibal, a total distance of 113 miles. Work will be started in Mexico about Nov. 1 in both directions. Burns & Co. will purchase all material and let all sub-contracts.

ST. LOUIS, MO.—The Foresight Investment Company, which controls Forsyth Place, a residence section lying west of Washington University, has decided to operate its own lighting, heating and cold storage plants, plans for which have already been prepared. The plant will be run on the co-operative plan. A flat rate will be maintained, based on the number of rooms in each house. Every house owner will be given a share of stock. George J. Lewis is secretary of the company.

SIKESTON, MO.—Plans are being made by the Sikeston Ice, Light & Power Company for improvements and extensions to its plant, to be made between now and early spring, which will involve an expenditure of about $15,000. C. L. Clary is manager.

HELENA, MONT.—Bids will be received at the office of the city clerk until Oct. 18 for furnishing material for a municipal electric light system as follows: Five miles or more of No. 4 triple braided weatherproof wire, not to exceed 875 lb. to the mile in coils; 20 miles or more No. 6 triple braided weatherproof wire, not to exceed 600 lb. to the mile; 250 or more 35-ft. 7-in. top, white cedar, dry peeled poles; 100 or more 45-ft. 7-in. white cedar, dry peeled poles; two or more series arc transformers, 6.5 amp, 60 cycle, 50 or 75 lamps each; 15 transformers, 5 kw, 2200-110 volts; 100 or more series alternating-current street arc lamps, 6.5 amp, 60 cycle, 700 or more 40-watt series tungsten lamps; three regulators 16.5 kva series tungsten system; three or more transformers for series tungsten 5.5 amp. 60-cycle system; 50 or more lightning arresters for pole line; 500 or more street hoods complete with insulators, pole arms and sockets for series 40-watt tungsten lamps and accessories in accordance with specifications on file in the office of the city clerk, which will be mailed on application. J. A. Mattison is city clerk.

LIVINGSTON, MONT.—Work has commenced on the construction of the new power house of the Livingston Water Works & Electric Light Company. The plans for equipment provide for a motor-driven centrifugal pump of 1,500,000 gal. capacity.

STEVENSVILLE, MONT.—The Bitter Root Valley Irrigation Company has placed orders for complete equipment for an electric light plant to be installed at the model town of Three Mile. The machinery for the plant will cost about $3,000 and will furnish electricity for lamps and motors and for lighting the streets of the town.

TROY, MONT.—A co-operative telephone company has been organized to construct a telephone line to Bull Lake.

BEATRICE, NEB.—The Dempster Manufacturing Company is making extension to its foundry and implement factory and also increasing the equipment of its power plant, which will include the installation of a 150-hp Murray-Corliss engine and Allis-Chalmers electric generators and motors, which have already been purchased. The cost of the improvements is estimated at $40,000.

PAPILLION, NEB.—The State Railway Commission has authorized the Home Telephone Company, of Papillion, Neb., to issue capital stock to the amount of $10,000, increasing its capital to $37,450.

STERLING, NEB.—It is reported that a movement is on foot to organize a company to establish an electric lighting system in Sterling.

ORANGE, N. J.—The City Council has rejected the bids for construction of the municipal electric light plant and distributing system, which were received Sept. 20. Revised plans and specifications are being prepared by Runyon & Carey, of Newark, N. J.

RINCON, N. M.—William Palmer, Jr., has been granted a franchise to construct and operate an electric light plant in Rincon. Work has commenced on the erection of the plant.

SILVER CITY, N. M.—The Grant County Telephone Company will commence work at once on the extension of its Surro Mountain telephone line to the Azure Mining Company properties in Burro district.

BROOKLYN, N. Y.—The directors of the Kings County Electric Light & Power Company have voted to recommend to the stockholders an authorization of an issue of $5,000,000 in convertible debenture bonds, bearing interest at 6 per cent. Application will be made at once to the Public Service Commission for approval of the same. The proceeds of the debentures will be used to take care of development work of both the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company.

CLINTON, N. Y.—The Village Trustees have awarded the contract for furnishing electricity for operating the municipal electric light system to Charles A. Borst, of the Clinton Hematite Ore Mines. The contract is for a term of five years, and the prices are as follows: Electricity for 27 arc lamps at $35 each per year; for 20 incandescent street lamps of 32 cp at $15 per lamp per year, and electrical energy for commercial and residential lighting at eight cents per kw-hour. The Franklin Springs Paint Company now furnishes the service for which the town pays $40 each per year for arc lamps; for 32-cp incandescent lamps $20 per lamp per year and 10 cents per kw-hour for electricity for other purposes. Mr. Borst will install a plant at once at his mines so as to be ready to furnish electrical energy when the present contract expires next February. The village owns the distributing system.

COPENHAGEN, N. Y.—The Deer River Power Company, which is constructing a large power plant near Copenhagen, has commenced to acquire land for a storage reservoir near Carthage. A large retaining dam will be erected and several acres of land will be flooded. It is said that the company will extend its transmission line to Carthage.

HORNELL, N. Y.—Papers have been filed with the Secretary of State certifying to the consolidation of the Hornellsville Electric Railway Company, the Hornellsville & Canisteo Railway Company and the Canisteo Railway Company under the name of the Hornell Traction Company. The company is capitalized at $120,000. The directors are: Charles Adsit, George T. Rehn and Milo M. Acker, all of Hornell, N. Y.

LOWVILLE, N. Y.—The Public Service Company has authorized the Wetmore Electric Company to begin the operation of an electric light plant in the Village of Castorland and the Town of Denmark, and also to extend its distributing system in the Towns of Croghan and New Bremen for the purpose of furnishing electricity to the Villages of Beaver Falls and Naumburg.

NEW YORK, N. Y.—The contract for furnishing and installing two 12,500,000-gal. steam turbine pumps, two 225-hp water tube boilers and all accessories was awarded by the Board of Water Supply to the Lord Electric Company, of New York, N. Y., for $34,884.

PAWLING, N. Y.—The Pawling Electric Light & Power Company is planning to erect a new power plant, and will soon be in the market for an engine or turbine, electric generator, exciter, etc.

ROSLYN, N. Y.—The Public Service Commission, Second District, has approved of the consolidation of the Nassau Light & Power Company, the Nassau Gas, Heat & Power Company, the Floral Park Light & Power Company, of Roslyn, N. Y., and the Oyster Bay Electric Light & Power Company, of Oyster Bay, N. Y.

ASHEVILLE, N. C.—It is reported that the promoters of the Asheville & East Tennessee Railroad Company will ask $200,000 in bonds from Buncombe County; $100,000 from Asheville and $200,000 from Mitchell and Yancey counties toward the completion of its projected electric railway from Weaverville to connect with the Carolina, Clinchfield & Ohio Railway to the east. Electricity for operating the railway will be furnished by the W. T. Weaver Power Company, of Asheville, N. C., which has commenced work on the construction of a new power plant near Marshall on the French Broad River. The proposed railway will be 40 miles in length and will extend to Galax, to connect with the Carolina, Clinchfield & Ohio Railroad, giving Asheville direct connection with the coal fields of Virginia and West Virginia. The railway will carry both passengers and freight.

CHARLOTTE, N. C.—The Charlotte Consolidated Construction Company has applied to the Board of Aldermen for permission to separate its gas and electric system from its traction system. The company proposes to organize a company under the name of the Charlotte Gas & Electric Company to take over the lighting departments. The new company was chartered some months ago by E. D. Latta, president of the Charlotte Consolidated Construction Company.

GRAHAM, N. C.—The River Falls Cotton Mills Company, recently incorporated with a capital stock of $200,000, is planning to develop a water-power on Haw River and erect a hydroelectric plant to furnish electricity to operate its proposed new cotton mill. J. W. Menefee is president and treasurer and R. N. Cook, secretary.

HICKORY, N. C.—The Thornton Light & Power Company will begin using electricity furnished by the Southern Power Company about Nov. 1, and will expend $5,000 in making the change. It is said the Thornton Company will dispose of its old steam plant and generators.

ROCKY MOUNT, N. C.—The local telephone system is being improved by the installation of cables under the superintendence of F. C. Topleman, who is interested in numerous systems in eastern North Carolina.

SALISBURY, N. C.—Announcement has been made that the Bankers' Trust Company, of New York, N. Y., has taken an appeal from the decision of Judge Pritchard, in Federal Court, in the case of the Whitney Power Company, in which is involved the question of the control of the $4,000,000 plant of the company on the Yadkin River. This appeal, it is said, will cause the suspension of all work on the plant now in course of construction under the direction of the receiver, Col. W. S. Henderson.

DAYTON, OHIO.—The City Council has approved the report submitted by City Engineer Cellarius for the installation of the boulevard lighting system in the district outlined by the Council, at a cost of $33,680.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company is planning to commence work at once of improving and remodeling its power station in Marietta.

YOUNGSTOWN, OHIO.—The court house building commission has awarded the contract for gas and electric light fixtures for the new court house to the Marreau Lighting Fixture Company, of Cleveland, Ohio, for $18,000.

ALTUS, OKLA.—Plans are being prepared for enlarging the municipal electric light plant and installing pumping machinery for an extensive water distributing system.

ELK CITY, OKLA.—The City of Elk City is receiving bids for $35,000 municipal light plant bonds. R. J. Carlile is city clerk.

HENRYETTA, OKLA.—Edwin R. Knecht, of Shelbyville, Ill., has been granted a franchise to erect an electric light and power plant. Under the terms of the franchise work is to commence on construction of the plant within 60 days and is to be completed within eight months.

MULHALL, OKLA.—It is reported that an electric light plant will be installed in Mulhall in the near future.

MUSKOGEE, OKLA.—The Muskogee Electric Traction Company will soon commence work on the construction of 2½ miles of track, for which ties and rails have been purchased.

OKLAHOMA CITY, OKLA.—Bids will be received at the office of B. Parman, city clerk, until Oct. 18 for furnishing and installing pumping engine, high speed steam engine and electrical apparatus, in accordance with plans and specifications on file in the office of Vincent G. Shinkle, superintendent of water.

OKLAHOMA CITY, OKLA.—We are informed that the company which has been formed to construct an electric railway from Oklahoma City to Shawnee, has commenced construction work and is in the market for equipment. Two power stations will be erected, sites for which have not yet ben selected, in connection with the North Canadian River Water Power Company. Homer S. Hurst, of Holdenville, Okla., is president; Alfred Hare, of Oklahoma City, is secretary and general manager.

RYAN, OKLA.—F. H. Lancashire, engineer, Wilson Building, Dallas, Tex., has been engaged by the Town of Oklahoma to revise specifications and to do the engineering work in connection with the construction of municipal electric light plant, water works and sewers.

KALMATH FALLS, ORE.—The Reclamation Service contemplates establishing a plant along Link River to furnish power for operating the pumping stations in connection with the Klamath reclamation project.

OSWEGO, ORE.—The Oregon Iron & Steel Company, of Portland, Ore., is reported to have decided to construct a large hydroelectric plant at the outlet of Tulatin Lake to furnish power for its works in Oswego, and other industries. Plans for the plant and equipment have not yet been prepared.

PORTLAND, ORE.—Property owners along Sixth Street are considering the question of installing cluster lamps, ten lamps to the block, from Jefferson Street to the Union Depot.

PORTLAND, ORE.—The Coos Bay & Inland Electric Company, recently incorporated, is securing rights of way for an electric railway from Roseburg to Marshfield. The officers of the company are: Jacob Haas, president; Charles Ringler, secretary and treasurer.

PORTLAND, ORE.—Arrangements are being made for the installation of cluster lamps on Grand Avenue and East Morrison Street. Secretary Atchley, of the East Side Business Men's Association, and W. H. Newhall are interested in the project.

BERWICK, PA.—The American Car & Foundry Company is remodeling and extending the electrical equipment in its plant in Berwick, and will install additional motors.

BLOOMSBURG, PA.—Announcement has been made that work will soon be started on the extension of the Columbia & Montour railway from Berwick to Wilkes-Barre, a distance of 32 miles, and on the Danville & Bloomsburg Street Railway from Danville to Sunbury, 14 miles in length. It is expected that further extensions will be made to Shamokin and then throughout the West Branch. Both of the railways are controlled by the Columbia Power, Light & Railways Company, of Bloomsburg, Pa.

CANONSBURG, PA.—The Washington Electric Light & Power Company, which controls the Canonsburg Electric Light, Heat & Power Company, of Canonsburg, Pa., has commenced work on the construction of a substation in West End, Canonsburg, electricity for which will be supplied from the main power station at Washington, Pa. Improvements are being made to the plant of the company which will improve the service, and when completed a 24-hour service will be established. The local power station will be dismantled as soon as the transmission line from Washington is completed.

EBENSBURG, PA.—Work has commenced on the construction of an electric light plant in Ebensburg, which will provide electricity for lighting the streets of the town and for commercial and residential lighting. Conrad Brothers are interested in the project.

HOOVERSVILLE, PA.—The Somerset County Telephone Company is planning to make extensive improvements to its system and will install a new switchboard in its exchange. A new telephone line will be extended from Boswell to Somerset.

PHILADELPHIA, PA.—Plans have been completed for the illumination of the business section of the city embracing Market Street between the Delaware and Schuylkill rivers, and Walnut and Chestnut streets, between the Delaware River and Twenty-fourth Street. The plan provides for 150 sidewalk arc lamps on Market Street betwen the two rivers, where now there are but 50 lamps, and on Chestnut and Walnut streets combined, 456 arc lamps, where now there are but 97. The new lamps are to be supported in pairs on ornamental sidewalk poles, four to each block, and four posts, each with twin lamps, at street intersections. The total cost of the lamps and posts for the entire district is estimated at $24,865; the cost of the maintenance of the additional lamps is estimated at $66,000 per year. It is said that the plan has the approval of the Mayor, and it is expected that the Citiy Councils will make an appropriation for the improvement.

DILLON, S. C.—Dr. Wade Stackhouse, who recently purchased the municipal electric light plant, has engaged F. M. Laxton, of Charlotte, N. C., electrical engineer, to make investigations in connection with the proposed improvements to the plant.

LEAD, S. D.—Plans are being prepared by the Homestake Mining Company for the construction of a large hydroelectric power plant. The company, it is said, will install new ore-crushing equipment this fall.

WATERTOWN, S. D.—The Dakota Central Telephone Company is contemplating equipping its local exchange with the automatic system.

BEEVILLE, TEX.—The Beeville Light Company is reported to have been granted a 40-year franchise by the City Council.

SALT LAKE CITY, UTAH.—Plans are being prepared by the Portland Cement Company for the installation of a breaker plant, crushing rolls, tube and ball mills, rotary kilns, boiler, engine and electrical equipment, comprising a complete manufacturing unit.

MONTPELIER, VT.—The Corry-Deavitt-Frost Company has awarded a contract to D. W. Cooley, of Waterbury, Vt., for the construction of a concrete dam, gates to the penstock and for foundation for power house No. 2, which will be located about 2000 ft. above the present plant at Kinney's Mills. The dam will be 150 ft. long and 12½ ft. high and will have a fall of 30 ft. The power house will be located about 1500 ft. below the dam and will be connected by a steel penstock. The proposed plant will have an output of about 1000 hp. The company furnishes electricity for operating the electric railway and has just entered into a contract with the Wetmore & Morse Company, of Barre, Vt., for a term of five years to furnish electricty for its quarries. The cost of extension is estimated at from $30,000 to $35,000.

LEXINGTON, VA.—The plant and holdings of the Lexington Mutual Telephone Company has been purchased by R. D. Moses and D. T. Odineal, both of Lexington, Va. It is reported that the price paid for the property was $25,000 and includes the Lexington and Buena Vista exchanges. The officers of the new company are: R. B. Moses, president, and D. P. Odineal, secretary-treasurer and general manager.

RICHMOND, VA.—E. W. Trafford, consulting engineer for the municipal electric light plant, has submitted to the Council committee on water and lights his report on the cost of the distributing system, which provides for 960 arc lamps, based on overhead construction, including an overhead transmission line to the city hall, and nearby public buildings, with entire new equipment, which he estimates will cost $72,000. In addition to the above a separate statement was presented giving the cost of the erection of a transmission line from the electric light plant to the pumping station of the water works system, which is estimated at $9,737.

WINCHESTER, VA.—The Winchester & Washington City Railway Company is reported to be contemplating the construction of a large steam generating plant in Millville. The new plant will have an output of 1500 hp, which will be used as an auxiliary to the hydroelectric plant on the Shenandoah River. D. M. Swink is superintendent.

WOODSTOCK, VA.—Plans are being prepared for the construction of a hydroelectric plant on the Shenandoah River, about two miles from Woodstock, a site for which has already been purchased. The proposed plant will furnish electricity for lamps and motors in this city. H. B. Chapman and others are interested in the project.

BELLINGHAM, WASH.—A permit has been granted for the construction of a new power and heating plant for Saint Joseph's Hospital. The cost of the building is estimated at $2,500.

METALINE, WASH.—The Lehigh Valley Cement Company has awarded the contract for the construction of its power plant to the Sylvester Engineering Company. The new plant will be located at the confluence of Sullivan Creek and the Pend Orielle River, just above Metaline Falls. The cost of the plant is estimated at $350,000.

NORTH YAKIMA, WASH.—The Northwest Light & Power Company has offered to sell its electric light plant to the city for $30,000, which is a reduction of $21,000 from the original offer. It is said that the last offer meets the approval of the Mayor and that arrangements will be made for the formal transfer of the plant to the city.

OAKVILLE, WASH.—Application has been made to the Town Council for a franchise to install electric light and water systems in Oakville. Mr. Shoemaker agrees to have the electric plant in operation by the latter part of December and to start work on the water system within four months.

SEATTLE, WASH.—Architects Gould & Champney have completed details for a new building planned for the Seattle Electric Company to be erected on the south side of Olive street between Sixth and Seventh avenues, at a cost of $150,000. The Stone-Webster Enginering Company will erect the building.

CAMERON, W. VA.—T. B. Cox, of Sherrard, W. Va., is reported to be interested in a project to construct an electric railway between Cameron and Wheeling, a distance of 20 miles.

CLEAR CREEK, W. VA.—A telephone company has been organized in Clear Creek for the purpose of erecting a telephone line between Clear Creek and Lawson. The line will be ten miles in length and will extend through Artie and Colcord.

AMHERST, WIS.—Preparations are being made by B. E. Dwinnell & Company, of Amherst, Wis., for enlarging their hydroelectric plant, which will include the construction of a concrete flume and the installation of new turbines, electrical machinery, etc.

JANESVILLE, WIS.—The Janesville Electric Company has purchased the Indian Ford dam and power plant of Captain P. Norcross. The company now owns, in addition, the dam at Fulton and two plants in Janesville, aggregating 2000 hp. It is understood that transformers and a new switchboard will be installed and other improvements made to the Indian Ford plant.

OSHKOSH, WIS.—The Paine Lumber Company, of Oshkosh, Wis., is said to be contemplating increasing the output of its power plant by the installation of steam turbines and generators having a total rating of 2000 kw.

OSHKOSH, WIS.—Plans are being considered by the Board of Regents for the construction of a power and heating plant for the Oshkosh Normal School Building, for which an appropriation of $18,000 has been made. It has not yet been decided whether an electric generator will be installed to furnish electricity for lighting the building, but space will be provided for it in the building.

LETHBRIDGE, ALTA, CAN.—A local company is being formed to build an electric street railway system with lines to adjoining settlements and towns.

CRESTON, B. C., CAN.—The Creston Light, Power & Telephone Company is putting the finishing touches to its telephone system, which will be in operation before the end of October. Several long distance lines will be built in the immediate future.

NEW WESTMINSTER, B. C., CAN.—The British Columbia Electric Street Railway Company has closed the contract for the erection of five power stations between New Westminster and Chilliwac. The stations will furnish electrical power for railway purposes and also for the distribution of electricity to the settlers. R. H. Sperling, of Vancouver, is general manager.

PRINCE RUPERT, B. C., CAN.—The Grand Trunk Pacific Railroad Company is installing a modern telephone system. For further information address A. B. Smith, manager of telegraphs, Winnipeg, Man.

SYDNEY, N. S., CAN.—The Cape Breton Electric Company has been asked by the City Council to make a number of extensions to both its railway and lighting systems.

BARRIE, ONT., CAN.—John W. Moyse, of Toronto, Ont., has submitted a proposition to the City Council to build an electric street railway system in Barrie with radial lines to adjacent villages and settlements, and to connect the Canadian Northern and Canadian Pacific railways.

BRANTFORD, ONT., CAN.—The Brantford Street Railway Company is asking permission of the City Council to make certain extensions.

HAMILTON, ONT., CAN.—After several years of legal controversy the city is free to take electric power from the Ontario Hydro-Electric Commission. An injunction was taken out by R. S. Morris, a local ratepayer, but it has been thrown out by Chief Justice Sir William Meredith. An agreement is being drawn up for this city to take 1000 hp from the Ontario Hydro-Electric Commission.

NIAGARA FALLS, ONT., CAN.—The Ontario Power Company has commenced preliminary work on the construction of another pipe line in Victoria Park, which will extend from the gate house at the head of Dufferin Island to the power house in front of the Horseshoe Falls. The new line will cost about $1,000,000, and will be a duplicate of the first, a steel tube 20 ft. in diameter, enclosed in concrete. The new pipe line is being constructed so as to enable the Ontario Power Company to fulfill its contract with the Hydro-Electric Power Commission to supply the Ontario municipalities with electricity.

PORT ARTHUR, ONT., CAN.—H. S. Acres, engineer for the Hydro-Electric Commission, is here making arrangements for the substation for the distribution of power.

PORT ARTHUR, ONT., CAN.—The Ontario Hydro-Electric Commission has offered to supply Port Arthur with power for $17 per hp with an ultimate reduction in price to $13.

STURGEON POINT, ONT., CAN.—S. Anderson, who owns and operates 40 miles of electric railway in this vicinity, is reported to be considering the construction of an electric railway from Fenelon Falls to Bobcageon via Sturgeon Point.

TORONTO, ONT., CAN.—It is reported that the Standard Sanitary Manufacturing Company, of Pittsburgh, Pa., is planning to construct a Canadian branch manufacturing plant in Toronto, Ont., Can., at a cost of $500,000. It is said that $500,000 additional will be spent for equipment and securing electrical power from Niagara Falls. The plant will be fully equipped for electric motor drive. An auxiliary steam plant will also be provided.

WELLAND, ONT., CAN.—B. Corey has applied for a franchise to operate a street railway system in Welland. It is expected extensions will be built to Port Colbourne and Niagara Falls.

MONTREAL, QUE., CAN.—The city has received permission from the Quebec Legislature to borrow money to install a high-pressure fire-protection service, to purchase the property of the Montreal Water & Power Company and for conduit work.

VERDUN, QUE., CAN.—Bids have been asked for the construction of a building for the new municipal electric light plant. It is expected to have the plant in operation by next March.

CARNDUFF, SASK, CAN.—This town is installing a municipal electric light and power plant, which will be in operation before the end of the year. Electricity will also be supplied for domestic purposes.

GUADALAJARA, MEX.—Plans are being considered by the Guanajuato Power & Electric Company for the erection of a transmission line into the City of Aguascalientes to supply electricity to the general shops of the National Railways, the smelter of the American Smelting & Refining Company and other manufacturing plants. The company has recently issued $80,000 in bonds and will soon commence work on the construction of a third power plant on the Angulo River in Michoacan, which will give the company a total output of 22,000 hp.

New Industrial Companies.

F. ALEXANDER, INC., of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 to manufacture electric lamps and electric articles. The incorporators are: Focsaneanu Alexander and Louis Liebes, and John M. Raymond, of New York, N. Y.

THE AMBURSEN COMPANY, of South Berwick, Maine, has been incorporated by W. Thompson and F. A. Hobbs, both of South Berwick. The company is capitalized at $200,000, and proposes to do mechanical and electrical work.

THE BALLIN WATER TUBE BOILER COMPANY, of Portland, Ore., has been incorporated with a capital stock of $50,000 by Fred A. Ballin, Arthur Langguth and Edward G. Gordon.

THE BIXLER MANUFACTURING COMPANY, of Springfield, Ill., has been chartered with a capital stock of $2,500 to manufacture electrical and dental supplies by John W. Bixler, M. E. Bixler, James De Bixler and George M. Morgan.

THE CLEMORE MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated by Charles M. Carpenter, Simon La Grou, C. Doolittle and Duncan Moore. The company is capitalized at $15,000 and proposes to manufacture street railway equipment.

THE ELECTRIC THEATER SUPPLY COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $10,000 by Albert W. Sanderson, of Philadelphia, Pa., treasurer; Matthew Brady, Horace D. Sansom and Albert W. Sansom, all of Philadelphia, Pa.

THE HOUSTON MANUFACTURING COMPANY, of Rockford, Ill., has been incorporated with a capital stock of $10,000 to manufacture vacuum cleaning devices. The officers of the company are: C. S. Brantingham, president; E. P. Lathrop, vice-president, and F. K. Houston, secretary and treasurer.

THE HYDROELECTRIC CONSTRUCTION COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $200,000 by W. A. Insinger, J. A. Bennett, Frank MacKean, Harry F. Reynolds and J. S. Perky.

THE McCANN BROTHERS' CONSTRUCTION COMPANY, of Murphysboro, Ill., has been incorporated with a capital stock of $40,000 for the purpose of doing general construction work. The incorporators are: P. S. McCann, J. McCann and C. McCann, of Murphysboro, Ill.

THE POTTSTOWN CONDUIT COMPANY, of Pottstown, Pa., has been incorporated with a capital stock of $5,000. The directors of the company are: Herbert G. Williams, treasurer; William L. Binder, Fred S. Roesch, all of Pottstown, Pa.

THE ROCHESTER TELEPHONE MUFFLER COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $10,000 by Mortimer E. De Witt, Frederick W. Zoller and Arthur G. Moore, all of Rochester, N. Y.

THE SIMPLEX GAS ENGINE STARTER COMPANY, of Chicago, Ill., has ben incorporated with a capital stock of $20,000 to manufacture automobile parts. The incorporators are: Edwin A. Gardner, Christopher Baldacci and Louis Funal.

THE WESTSIDE POWER COMPANY, of San Francisco, Cal., capitalized at $25,000, has been incorporated by George Pollock, E. A. Clausen and G. S. Borkley.

THE WEST SIDE CABLE COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $2,000 by A. B. Coon and others.

THE WHELCHEL ELECTRIC COMPANY, of Anderson, Ind., has been formed with a capital stock of $25,000 to manufacture electrical supplies. The directors are: Bert Whelchel, I. W. Jones, A. S. McCall and John Rickes.

New Incorporations.

LAKEPORT, CAL.—The Highland Pacific Railroad Company has been chartered with a capital stock of $2,500,000 for the purpose of taking over the holdings of the Sonoma & Lake County Railroad Company, which proposes to construct an electric railway from Upper Lake to Lakeport, and a branch three miles in length frm Kelseyville to the nearest point

on the main line in Big Valley, in addition to the route previously mapped out, from Lakeport to Preston and on to Santa Rosa. The total length of the railway is estimated at 70 miles. Most of the right of way has been secured. The incorporators are: J. E. Fulton, R. M. Beattie, A. E. Dickinson and Henry Eickoff, of San Francisco, Cal.

LOS ANGELES, CAL.—The Tidewater Northern Railway Company has filed articles of incorporation with a capital stock of $800,000 for the purpose of constructing an electric railway along the coast from Santa Monica to Ventura. The incorporators are: R. N. Hart, R. H. Barr and J. S. Wallace.

PUEBLO, COL.—The Pueblo & San Luis Valley Railroad & Power Company has been incorporated with a capital stock of $8,000,000. The company proposes to construct a steam railroad from Pueblo to Fremont County and the West Mountain Valley, reaching Silver Cliff and other towns in the State. The steam road will terminate at Alamosa, Monte Vista or Del Norte, but will be continued by an electric railway, which will extend to Pasgosa Springs and Durango.

ROMEO, COL.—The Romeo Rural Telephone Company has been incorporated, with a capital stock of $500, by George H. Berry, W. H. Vassar and E. M. Crow.

DOVER, DEL.—The Sun Telegraph & Telephone Company has been chartered with a capital stock of $50,000 by Terry W. Allen, John F. Wisdon and W. G. Timperlake, all of Jackson, Tenn.

WILMINGTON, DEL.—The North Dakota Heat & Power Company has been incorporated, with a capital stock of $200,000, by F. M. Shive, S. E. Robertson and Harry W. Davis, all of Wilmington, Del.

ASHLEY, ILL.—The Ashley Telephone & Telegraph Company has been incorporated, with a capital stock of $5,000, by H. A. Walker, C. H. Walker and M. Kay.

DELPHI, IND.—The Delphi, Flora & Burlington Traction Company has been incorporated with a capital stock of $25,000 by E. W. Bowers, president; J. C. Smock, secretary, and others. The company proposes to construct a traction system from Delphi to Burlington, via Flora.

RICHMOND, IND.—The Liberty Light & Power Company has filed articles of incorporation with the Secretary of State, with a capital stock of $25,000. The company proposes to generate and distribute electricity to towns and cities for heating, lamps and motors. Robert S. Asher, John A. Perkins, Winfred Jessup and Gordon E. Varney are directors.

SEDAN, KAN.—The Pecan Creek Telephone Company has been incorporated, with a capital stock of $500, by P. E. Ross, Kelly Askew and J. H. Zimmerman.

AUGUSTA, MAINE.—Articles of incorporation have been filed for the Sonora Telephone Company, with a capital stock of $600,000. The officers are: M. E. Gould, president, and F. L. Dutton, treasurer and clerk.

MINNEAPOLIS, MINN.—Articles of incorporation have been filed for the Lake Minnetonka Public Service Company by Henry W. Benton, Leo M. Crafts and Joseph S. Wenster. The company is capitalized at $150,000, and proposes to supply villages along the shore with electricity for lamps.

HIGBEE, MO.—The Citizens' Electric Light Company has been incorporated, with a capital stock of $5,000, by S. H. Hirsch, H. C. Eubank, T. J. Cooper and others.

ST. JOSEPH, MO.—Articles of incorporation have been filed for the St. Joseph & Savannah Railway Company by J. H. Van Brunt, C. E. Foster, Jr., James N. Burnes, J. S. McDonald, Charles Pasche, John Donavan, G. G. Lacy, J. G. Schneider and R. A. Brown. The company is capitalized at $350,000, and proposes to construct an electric railway from St. Joseph to Savannah, a distance of 15 miles. This company is said to be a subsidiary of the St. Joseph Railway, Light, Heat & Power Company.

BUTLER, N. J.—The Butler Electric Light & Power Company has been incorporated with a capital stock of $50,000. The incorporators are: E. O. Jones, of Rutherford, N. J.; J. B. Lydecker, of Bloomingdale, N. J., and H. R. Schneider, of Westwood, N. J.

TRENTON, N. J.—Articles of incorporation have been filed for the Continental Telegraph & Telephone Company by William M. Clark, of Plainfield, N. J.; Powell Crichton and William E. Conley, both of New York, N. Y. The purpose of the company is the amalgamation of telephone and telegraph lines. The company is capitalized at $50,000,000.

BATAVIA, N. Y.—The Genesee Light & Power Company has been incorporated with a capital stock of $250,000. The company is a reorganization of the Genesee County Electric Light, Power & Gas Company, and will operate in the villages and towns in Genesee County. The directors are: Walter C. Lewis, of Boston, Mass.; George M. Kimball, of Concord, N. H.; Ferdinand W. Keller, of New York, N. Y., and John K. White, of Tonawanda, N. Y.

CARROLLTON, N. Y.—The Carrollton Electric Company has been chartered, with a capital stock of $25,000, to operate a light, heat and power plant.

ELIZABETHTOWN, N. Y.—Articles of incorporation have been filed for the Elizabethtown Terminal Railroad Company, with a capital stock of $80,000, to operate a railroad either by steam or other motive power. The proposed railway is to extend from the Delaware & Hudson station at Westport to Elizabethtown. The directors are: Richard L. Hand, Francis L. Smith and George W. Jenkins, of Elizabethtown, N. Y.

HAMBURG, N. Y.—Artices of incorporation have been filed for the Howard A. Pierce Electric Light Company by H. A. Pierce, E. Pierce and L. S. Frank, of Hamburg, N. Y. The company is capitalized at $30,000, and proposes to furnish electricity for lamps, heat and motors.

PORT JERVIS, N. Y.—Articles of incorporation have been filed for the Port Jervis Traction Company by J. E. Daily, J. V. Torney, of New York, N. Y., and T. H. Milson, of Paterson, N. J. The company is capitalized at $43,000.

SNOW HILL, N. C.—The East Carolina Electric & Realty Company has been chartered, with a capital stock of $25,000, for the purpose of constructing telegraph or telephone lines, by S. L. Lynch, of Kinston, N. C.; W. H. Wells, of Snow Hill, and others.

CLEVELAND, OHIO.—The Gillen Electric Company has been incorporated, with a capital stock of $10,000, by E. J. Gillen, S. A. Gillen, Vincent J. Rogers, Herman Dorsey and W. J. Wilson.

SPRINGFIELD, OHIO.—The Consumers' Light, Heat & Power Company has been incorporated by James B. Malone and others. The capital stock of the company is placed at $50,000.

XENIA, OHIO.—The Xenia, Lighting Company, with a capital stock of $20,000, has been incorporated by P. H. Flynn and others.

CHARLESTON, OKLA.—The Home Rural Telephone Company has been chartered, with a capital stock of $1,500, by F. Z. Winfell, A. L. Rodkey, J. A. Hickory and M. A. Treadway, of Charleston, Okla., and H. J. Jordon, of Protection, Kan.

JENNINGS, OKLA.—The Jennings Refrigerator, Electric Light & Power Company has been incorporated with a capital stock of $10,000 by Frank Adams, J. C. Murphy and C. W. Shoemaker.

SEDAN, OKLA.—The Pecan Creek Telephone Company has been incorporated with a capital stock of $500 by P. E. Doss, Kelley Askew and J. H. Zimmerman, all of Sedan.

GLENWOOD, ORE.—The Klickitat Valley Development Company has been organized for the purpose of developing the water power of the upper Klickitat River to be utilized to generate electricity and the irrigation of 45 square miles in the Camas Prairie. William R. King, of Portland, Ore., and W. N. Coler, Jr., of New York, N. Y., are interested in the project. The plant will be located near the town of Glenwood on Camas Prairie, where it is estimated that 40,000 hp can be developed.

PORTLAND, ORE.—The Odin Falls Irrigation & Power Company has filed articles of incorporation with a capital stock of $90,000. The incorporators are: Charles M. Lanning, Joseph G. Houston and George Broughton.

BEAVER FALLS, PA.—Application has been made for a charter for the New Castle & Beaver Valley Railways Company to construct an electric railway from New Castle to Beaver Falls by Stewart S. Neff, Gerald Holsman, Hiram G. Miller, Robert W. Cunningham, John M. Morris, Leonard N. Uber and Joseph V. Cunningham.

BENTLEYSVILLE, PA.—The Bentleysville Electric Light, Heat & Power Company has been chartered, with a capital stock of $15,000. The directors are: E. E. French, of Ellsworth, Pa., treasurer; J. G. McCormick, Nicholas Veeser, of Bentleysville, Pa.; Charles F. Fisher, of Pittsburgh, Pa., and George C. Schlehr, of Ellsworth, Pa.

BOILING SPRINGS, PA.—The M. E. Kraybill Light, Heat & Power Company has been incorporated with a capital stock of $25,000 by Martin E. Kraybill, of Boiling Springs, Pa., treasurer; C. J. Kraybill, of Boiling Springs, Pa.; Benjamin E. Kraybill, of Mechanicsburg, Pa.; Amos E. Kraybill, of Johnstown, Pa., and John A. Herman, of Harrisburg, Pa.

FENELTON, PA.—The Fenelton Independent Telephone Company has been chartered to construct a telephone line from Fenelton to Chicora and Carbon Center, via Rattigan. The officers of the company are: F. P. McBride, of Fenelton, Pa., president; S. I. Pontius, of Chicora, Pa., vice-president; W. I. Sipe, of Fenelton, secretary, and P. S. Fennel, of Fenelton, treasurer.

HANOVER, PA.—The Hanover & Warrior Run Street Railway Company has been incorporated with a capital stock of $100,000 to construct an electric railway from Hanover to Warrior Run via Wilkes-Barre, a distance of six miles. The incorporators are: J. R. Scouton, of Wilkes-Barre, president; L. F. Camp, H. H. Davenport, and M. T. Rees.

INTERCOURSE, PA.—The Intercourse Electric Light, Heat & Power Company has been incorporated with a capital stock of $6,000 and the following-named directors: Ezra Zimmerman, of Intercourse, Pa., treasurer; E. K. Denlinger, Willis L. Zimmerman, all of Inercourse, Pa.

ROYERSFORD, PA.—Articles of incorporation have been filed for the Royersford Interurban Traction Company by Joseph A. Buckwalter, R. S. Raiser, of Royersford; A. B. Eddowes, W. W. Levering and W. H. Houston, of Philadelphia, Pa. The company is capitalized at $25,000 and proposes to construct an electric railway in Royersford, about four miles in length.

SLIPPERY ROCK, PA.—The Slippery Rock & Grove City Street Railway Company has been incorporated with a capital stock of $55,000 to construct an electric railway from Slippery Rock to Grove City, 9 miles in length. The incorporators are: John P. Barr, of Grove City, presi-

dent; W. Henry Wilson, James A. Jolliffe, S. L. McClure, C. S. Shrubb, John Carruthers and W. M. Graham.

ROCK HILL, S. C.—The Rock Hill Water & Electric Company has been chartered, with a capital stock of $100,000, by R. T. Fewell and P. A. Willcox. The company proposes to generate and distribute electricity for lamps and motors, and also supply water for domestic and commercial use.

ANGUS, TEX.—The Angus Telephone Company has been chartered, with a capital stock of $1,230, by R. Knight, T. Ware and A. H. Birdwell.

CROSBYTON, TEX.—Articles of incorporation have been filed for the Crosbyton Telephone Company with a capital stock of $10,000 by Julian M. Bassett, J. C. Johnson, Taylor Gault, and others.

OLTON, TEX.—The Olton Independent Telephone Company has been chartered, with a capital stock of $1,000, by H. R. Miller, D. C. Young and W. D. Wicker.

WALNUT SPRINGS, TEX.—The Glen Rose & Walnut Springs Railway Company has ben chartered with a capital stock of $100,000 to construct an electric railway 15 miles in length extending from Glen Rose to Walnut Springs. The incorporators are: Judge Sadler, J. H. Farr and others.

WILLS POINT, TEX.—The Wills Point Telephone Company has been incorporated, with a capital stock of $16,500, by O. L. Fink, E. F. Fink and H. F. Goodnight.

KAMAS, UTAH.—The Kamas-Woodland Telephone Company has filed articles of incorporation, with a capital stock of $12,000. The officers of the company are: Charles B. Stewart, president; J. O. Park, vice-president, and John B. Hoyt, secretary and treasurer.

SEATTLE, WASH.—Articles of incorporation have been filed for the Oregon & Washington Long Distance Telephone Company, with a capital stock of $1,500,000, by Samuel Hill, W. G. Collins and Henry Lindley.

SEATTLE, WASH.—The Collins Pacific Coast Wireless Telephone & Telegraph Company has been chartered with a capital stock of $2,000,000 by B. F. Shoemaker, C. O. White, Sylvester Sullivan and C. L. Vaughn.

TACOMA, WASH.—The Skagit, Cascade & Chelan Railway Company has been incorporated, with a capital stock of $25,000,000, by W. W. Shenk and others. The company proposes to construct an electric railway from Rockport to Spokane, with branches to Silver Basin and to the British Columbia line. Electricity for operating the railway will be generated on Thunder Creek.

LONETREE, WYO.—The Lonetree & Linwood Telephone Company has been incorporated, with a capital stock of $3,000, to construct and operate a telephone system from Lonetree to Linwood. The directors are: T. A. Welch, Robert D. Swift, Clark Logan, Sterling Summers and John Fluhman.

WINGHAM, ONT., CAN.—The North Huron Telephone Company has been incorporated, with a capital stock of $10,000, for the purpose of erecting and operating telephone lines in the townships of Turnberry, Morris, East and West Wawanosh, Howich, Kinloss, Culross and Carrich. The company has erected lines to the villages of Bluevale, Belmore, Belgrave and Whitechurch. Work on the new telephone lines will begin as soon as possible. George Spotton is president; W. J. Greer, vice-president; William Mapwell, managing director; H. B. Elliott, secretary and K. Vanstone, treasurer.

Personal.

MR. F. T. BODINE, of the Philadelphia Electric Company, has been appointed president of the Syracuse Lighting Company.

MR. SAMUEL INSULL will address the Chicago Electric Club Oct. 20; the topic to be, "The Sale of Electrical Energy in Chicago."

MR. GEORGE L. KNIGHT will present a paper before the Brooklyn Engineers' Club on Oct. 14, entitled "The Generating and Distributing System of the Brooklyn Edison Company."

MR. J. J. CUMMINS has resigned as president of the Syracuse Lighting Company in order to become associated with the Dunfee Construction Company. Mr. Cummins will remain a director of the Lighting Company.

DR. ELIHU THOMSON.—At the ceremonies attending the induction of President Lowell, Prof. Elihu Thomson received from Harvard University the degree of Doctor of Science in recognition of original work in electrical research.

MR. EDGAR W. MIX, who made the record flight in the recent international balloon contest for the James Gordon Bennett prize, is a member of the American Institute of Electrical Engineers, having entered as an associate in 1889, and was transferred to full membership in 1895. Mr. Mix has resided in Paris for many years, where he practises as an electrical engineer.

MR. FRANK VAIL BURTON, Eastern sales manager of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company, of Bridgeport, Conn., and Miss Marion Andrew, daughter of Mr. and Mrs. Thomas Winter Andrew, of Swarthmore, Pa., were married in the Walnut Street Presbyterian Church, in Philadelphia, on Saturday afternoon, Oct. 9. Mr. and Mrs. Burton will make their home in Bridgeport.

Trade Publications.

INDICATING FUSES.—The Detroit Fuse & Manufacturing Company, Detroit, Mich., is distributing revised price lists of its line of "Arkless" indicating fuses, which call special attention to the absolute guarantee placed on every "Arkless" fuse, and to the special features embodied in this line.

TUNGSTEN LAMP.—A small folder issued by the General Electric Company contains data relative to the 40-watt tungsten lamp, which should be of general interest. It shows in dollars and cents the saving resulting from the use of the tungsten lamp in place of the ordinary carbon lamp.

HARVARD CATALOGUES.—The Harvard Electric Company, of Chicago and New York, has just issued bulletin No. 19 relating to brackets, sectional switch boxes, conduit boxes, telephone fuses, wire joints, etc. In this bulletin there is given a detailed description of the various Harvard specialties, dimensions, etc.

GIRL PICTURES.—The General Incandescent Lamp Company, of Cleveland, Ohio, has once more started the distribution of the G. I. series of girl pictures taken from life. They sent out a very attractive set of five last season at different intervals. If the first one for this year is any indication of what may be expected of the others that are to follow they surely will be appreciated by the recipients. This is a very attractive form of advertising and the pictures are so artistic that many will find their way to the picture framer and will be hung permanently on office walls.

INDICATORS.—The Trill Indicator Company, of Corry, Pa., has just issued an attractive 44-page booklet describing its various types of indicators. The "Faultless" reducing motion, Trill planimeter and indicators for high pressure and ammonia work are also described. Discussions are included on numerous cards and the causes of various unusual curves pointed out. A method is given for drawing adiabatic and saturation curves, and a section treats the indicating of gas engines with discussions of faulty diagrams. There is also a section on indicating compound engines and drawing combined cards.

Business Notes.

THE TREGONING ELECTRIC MANUFACTURING COMPANY, of Cleveland, O., owing to a largely increased business, has removed its plant from 224 High Street to 418 West Prospect Avenue. The new factory is equipped with much additional machinery and equipment for the manufacture of the Tregoning specialties.

PASS & SEYMOUR NEW YORK OFFICE.—Mr. W. Brewster Hall has been promoted to the position of assistant sales manager of Pass & Seymour, with headquarters at Solvay. The New York office will be in charge of Mr. F. S. Baldwin, late of the Syracuse Supply Company, who has been engaged in the electrical jobbing business for the past five years.

STEINER FAMILY MOTORS.—St. Louis last week enjoyed a centennial celebration, on one day of which there was a parade of floats. One of those which attracted most favorable attention was entered by the Steiner Manufacturing Company. This consisted of a flower-trimmed body on which Steiner family motors were shown in actual operation applied to various domestic uses.

HENRY F. FROSCH & COMPANY.—Henry F. Frosch & Company announce the removal of their office and warerooms from 656-658 Howard Street, to the Electric Building, 171-173 Second Street, San Francisco. The company represents the following firms on the Coast and carries a complete stock for immediate delivery: Federal Electric Company, Chicago, Ill.; General Incandescent Lamp Company, Cleveland, O.; Albert J. M. Anderson Manufacturing Company, Boston; Minerallac Electric Company, Chicago, Ill.; Crescent Company, Valpariso, Ind., and Excello Arc Lamp Company, New York City, N. Y.

TANTALUM LAMPS.—The General Electric Company reports very gratifying sales of tantalum lamps. The sales of this lamp are more than double what they were a year ago, and the lamp appears to be sharing in the demand for high-efficiency lamps created by the introduction of tungsten lamps. The tantalum lamp, as at present supplied, is giving excellent life service. Contrary to general belief, these lamps will give good commercial life on alternating current of 60 cycles or less. Their life on this frequency will average well above 600 hours. An interesting tantalum lamp order recently received called for 1900 lamps for the U. S. war vessels attending the Hudson-Fulton celebration in New York.

ANOTHER ACHESON EXTENSION.—Another substantial and commodious building is to be added to the Niagara Falls, Ont., branch works of the International Acheson Graphite Company. The structure is to be 50 ft. wide by 105 ft. long, and the contract has been awarded to W. S. Homan, of Niagara Falls, Ont. The facilities afforded by this addition will make the Canadian works of the graphite company quite complete in its ability to care for a rapidly growing trade due to Canada's industrial growth. The building will contain a new grinding plant, in which the lubricating, electrotype, and other grades of powdered graphite will be prepared for market. It will also contain a stock room for package goods, such as graphited greases, powders, etc., while a new shipping room will make it most convenient for promptly filling orders.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 5, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

935,682. GEARING FOR LOCOMOTIVE RECORDING INSTRUMENTS; S. T. Park and J. E. Phillips, Danville, Ill. App. filed Dec. 21, 1908. Gearing for actuating the paper feeding device of a recorder on a locomotive which records the tractive force, the steam pressure, the air pressure, etc.

935,705. STRAIN RELIEVING MEANS FOR TERMINALS OF LAMP SOCKETS, etc.; F. A. Swan, Cliftondale, Mass. App. filed Apr. 15, 1908. Provides a flat terminal strip with a headed strain relief projection extending laterally from the flat side of the terminal strip about which the conductive wire may be wrapped.

935,721. WIRELESS TELEGRAPH SYSTEM; V. C. De Ybarrondo, Los Angeles, Cal. App. filed Jan. 2, 1909. A central switchboard with suitable wiring in position so as to be connectable with the aerial and sounding apparatus.

935,750. DEVICE FOR PRODUCING SOUND SIGNALS IN WATER; H. B. Gale, Boston, Mass. App. filed Mar. 5, 1906. Includes a water-tight case capable of vibration and of transmitting sound, together with a striker within the case which strikes a thickened portion of the internal wall of the case.

935,768. ELECTRIC BLOCK SIGNALING SYSTEM; W. F. Meschenmoser, Hoboken, and C. H. Kinsman, Plainfield, N. J. App. filed July 24, 1908. For single track roads in which two pairs of setting and restoring track magnets are used, a shunt track circuit for each magnet connected with insulated track sections at opposite ends of the block, and signals at opposite ends of the block controlled by the magnets.

935,792. TELEPHONE RINGER; N. P. Jensen, Waterloo, Iowa. App. filed Jan. 9, 1909. The cores of the electromagnet which operates the ringer are hollow and a compression spring is seated in the hollow of each core to move the armature in one direction.

935,796. PRODUCTION OF MAGNESIUM; F. Von Kugelgen, Holcombe's Rock, Va., and G. O. Seward, East Orange, N. J. App. filed July 8, 1907. Electrolizes a magnesium salt with a cathode of molten aluminum, producing a magnesium aluminum alloy and dissolves out the magnesium by using it as an anode in a molten electrolyte, depositing the magnesium at the cathode.

935,816. ELECTRIC HEATER; W. A. Rankin and W. M. Harwood, Hutchinson, Kan. App. filed Oct. 23, 1908. For sad irons and the like, in which the side opposite the acting face is provided with an integral raised portion and a multiplicity of slots and two layers of zigzag grids in the slots.

935,838. REVERSIBLE FUSED AND SOLID TERMINAL; R. H. Conway and H. E. Bisbing, Philadelphia, Pa. App. filed Nov. 20, 1908. A turning plug which in one position constitutes a fused circuit closer and in another a solid circuit closer.

935,852. TROLLEY WHEEL; A. M. Levering, Philadelphia, Pa. App. filed Oct. 1, 1908. Permits a pivotal movement of the rim of the wheel with relation to the body to permit it to follow curves. Comprises a central disc with aligned longitudinal openings therein, pins in the openings of greater length than the openings, and a rim on the disc with recesses to receive the pins.

935,881. SINGLE PHASE MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Dec. 26, 1907. A single-phase motor of the commutator type with inducing and exciting windings on the stator and a reactive winding in stator slots, connected to the exciting winding and arranged non-inductively with respect to the other windings.

935,892. ELECTRIC SIGNAL FOR RAILWAYS; A. C. Carey, Boston, Mass. App. filed Nov. 21, 1907. A conductor is arranged alongside of the track and co-operates with mechanism in the cab of the locomotives, including an audible alarm and means for actuating the air brake, with a regulator for the current.

935,895. TROLLEY WIRE SUPPORT; R. O. Couch, Charleston, W. Va. App. filed Mar. 20, 1909. Hangers for trolley wires, including a base block, a clamp which grips it and supports the wire, the block having a water shed overhanging the clamp, and a second water shed overhanging the base block and members secured thereto.

935,896. ARC LAMP; J. T. H. Dempster, Schenectady, N. Y. App. filed May 1, 1905. Arc lamps with a feed for the electrodes. Includes a pair of main electrodes and an auxiliary electrode, the lower main electrode including an iron tube filled with a mixture of oxides of metals, and the auxiliary electrode being used to warm the arcing end of the main electrode.

935,897. MICROPHONE; C. E. Egner, Stockholm, and J. G. Holmstrom, Saltsjostorangen, Sweden. App. filed Mar. 27, 1908. Includes a sealed casing having one wall formed by the vibratory diaphragm, the casing being charged with hydrogen.

935,908. ARC LAMP; C. D. Haskins, Schenectady, N. Y. App. filed Feb. 18, 1907. In order to feed electrode, makes it of material in a plastic state which is fed progressively.

935,915. ELECTRIC SWITCH AND OUTLET BOX; A. H. Kling, Detroit, Mich. App. filed Apr. 16, 1908. Two similar units with ears extending inwardly and interchangeable end plates.

935,920. ARC LAMP; E. J. Murphy, Glasgow, Scotland. App. filed Oct. 26, 1906. An arc lamp frame having a hood, a platform, parallel channel bars, the ends being bent laterally to form ears which are secured at one end to the hood and at the other end to the platform.

935,923. CONDENSER; F. J. Newton, Schenectady, N. Y. App. filed Nov. 8, 1906. A plurality of metal plates, some of which are enameled, lugs on the plates and parallel conducting rods passing through the lugs to make electrical connection with the plates.

935,934. MAIL BOX; F. H. Sieh and F. L. Lowe, Minneapolis, Minn. App. filed June 24, 1909. Has a spring controlled block in the path of the lever which controls an alarm.

935,935. ELECTRIC ANNUNCIATOR; A. J. Smith, Bath, Me. App. filed Oct. 29, 1908. A sliding gravity drop retained in position by a mechanically actuated catch. Details.

935,937. ELECTRIC FURNACE; W. A. Smith, Niagara Falls, N. Y. App. filed June 15, 1909. The walls of the furnace are perforated and permeable to the gaseous reaction products.

935,939. ELECTRICAL FURNACE TERMINAL; E. C. Speiden, Niagara Falls, N. Y. App. filed June 17, 1909. The terminal includes graphite members spaced in the direction of the current flow and an interposed filling of electrically conductive material of relatively low heat conductivity.

935,941. ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 13, 1908. The armature is wound with uniform coils of a pitch which prevents the induction in said coils of one harmonic of the induced e.m.f., and certain of the coils are offset with respect to other coils in series therewith to eliminate another harmonic.

935,942. PROCESS FOR MAKING SUGAR; C. P. Stewart, Los Angeles, Cal. App. filed Mar. 6, 1908. Effects a chemical reaction between mixed carbon monoxide and hydrogen obtained by passing superheated steam to the carbon; cools, compresses and passes an electric current through the mixed gases.

935,972. SAFETY SWITCH LOCK; A. Haddock and A. Schmitt, New York, N. Y. App. filed Nov. 13, 1908. A safety switch lock adapted to engage a switch point with a motor and spring for actuating it and an electromagnetic catch and motor for controlling it.

936,001. DRY-CELL TESTER; E. S. Lincoln, Brookline, Mass. App. filed Mar. 6, 1908. Contact members are located upon the exterior of the casing and a solenoid magnet within it. A drum is mounted upon the core of the magnet and bears a strength indicating scale upon its periphery. A spring tends to eject the core from the magnet.

936,009. TELEPHONE STAND; E. A. Metcalf, Forbes, Mo. App. filed Nov. 11, 1908. A telephone stand carrying a ring with arms projecting from opposite sides and a pair of seats on the ring, together with a receiver arm pivoted to the stand and normally resting upon one of the above seats.

936,039. ELECTROLYTIC APPARATUS; I. L. Roberts, New York, N. Y. App. filed Apr. 3, 1905. Making porous diaphragms for cells of woody material and then partially carbonizing the same.

936,055. TROLLEY GUARD; S. Stroup, Peru, Ind. App. filed Aug. 18, 1908. A trolley guard including retainers normally above the top of the wire which yield when they strike a hanger.

936,067. INCLOSED METER LOOP; E. C. Wigham, Boston, Mass. App. filed Apr. 19, 1909. A meter loop block having contacts accessible for connection to service and enclosed and insulated from one-another.

936,071. MOTOR CONTROL; E. F. W. Alexander, Schenectady, N. Y. App. filed Dec. 17, 1907. For alternating current motors of the commutator type having a controlling switch arranged to short-circuit the motor armature and connect the stator windings in series with a reactive coil in shunt to the exciting winding at starting. The magnet circuit of the coil is saturated by the starting current.

936,100. TROLLEY WHEEL AND HARP; F. L. Eager, Waterbury, Conn. App. filed Oct. 3, 1906. A base for a trolley harp having ears projecting therefrom, a carrier, a trolley wheel on the carrier and contacts pressing against the wheel.

936,116. SAFETY APPLIANCES FOR ELECTRIC ELEVATORS; C. S. Gilbert, St. Joseph, Mo. App. filed Dec. 28, 1908. A brake operated electrically with means for preventing the starting and stopping mechanism of an elevator from being moved after the electric current has been cut off until the armature of the motor has ceased to revolve.

936,140. TELEGRAPH SYSTEM; W. Leivesley, Springsure, Queensland, Australia. App. filed Aug. 7, 1906. A telegraph system having a main circuit, a key and a principal relay therein, a repeater and a battery.

936,163. RECEIVING SYSTEM FOR ELECTRICAL OSCILLATIONS; E. Quack and F. v. d. Woulde, Berlin, Germany. App. filed Apr. 27, 1908. For receiving waves in the Pederson system. The detector is permanently included within the oscillating circuit, and the condenser in parallel to the detector is intermittently connected with the circuit by an interrupter device.

936,175. PUSH BUTTON SWITCH; F. E. Seeley, Bridgeport, Conn. App. filed Apr. 21, 1909. A push button switch having a hollow push button and a visible indicator within the same operated by the switch mechanism.

936,195. CLAMP; J. H. Umpleby, Friendly, W. Va. App. filed Nov. 3, 1908. For splicing together the ends of wires by means of a gutter-shaped sleeve and keys securing the wires to the sleeves.

936,207. TELEPHONE TRANSMITTER; C. D. Babcock, New York, N. Y. App. filed Apr. 17, 1909. For wireless telegraphy, the transmitter including oxide of a metal whose conductivity becomes extremely sensitive at a certain critical temperature with controllable means for heating the oxide.

936,208. ELECTRIC BRUSH; M. E. Bacon and L. J. Meller, Deerfield, Kan. App. filed Oct. 19, 1908. For supplying electrical current to brushes used in massage. Details.

936,227. ELECTRICAL FUSE; A. Grant Fay, Highland Park, Ill. App. filed Oct. 26, 1908. Provides an outer shell and a filling, the ends of the outer shell being reduced for sharpening the effect of the detonation of the fuse.

936,252. METERING PANEL BOARD; A. C. McWilliams, Chicago, Ill. App. filed Oct. 23, 1907. The panel board includes an insulating board, two sets of conductors permanently mounted thereon and arranged in parallel planes.

936,255. AUTOMATIC SIGNAL SYSTEM; J. S. Payne, Mulvane, Kan. App. filed Mar. 2, 1909. Displays a danger signal at the proper time and provides a riding link struck by the locomotive to effect the operation of the signal.

936,258. RECEIVER FOR SPACE TELEGRAPHY; W. Schloemilch, Oberschoneweide, near Berlin, Germany. App. filed Jan. 3, 1906. An electrolyte, electrodes of different materials in contact therewith to form a primary battery and a local circuit, including an indicator influenced by variations of current in the circuit.